*Some Causes of Underground Cable Failure—Measurement of Reflection Factor and Other Articles of Interest to Engineers and Central-Station Managers.*

# Electrical World

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# Electrical World

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## Advantages of Interconnection

THE high price of fuel as well as of all supplies needed by central stations, the increasing market for energy and the inability to secure generating equipment promptly all indicate the necessity of interchange of electrical energy through the interconnection of contiguous generating systems. The surplus capacity of one system can then be utilized by some other system having need for it; maximum use will be made of investment and of equipment; reliability of service will be increased, and great economies will be possible. Aside from the patriotic duty to conserve the coal supply, there is the selfish duty of caring for the business and, if possible, earning dividends besides. Interconnection of distributing systems offers a timely and welcome solution to these present difficulties. It is not necessarily a war move, although that of itself is sufficient justification. In physical and electrical union there is strength, and we venture to predict that once tied together interconnected electrical generating systems will never again break up into individual units. The advantages are too great to be lightly cast aside.

## Engineering Experiment Stations

WE PUBLISH in this week's issue a comparative table of the principal provisions of three bills which have been recently introduced in Congress and which have for their common object the promotion of engineering research. While it is not likely that any of these bills will come up for consideration under the present troubled conditions, each represents the result of some study and discussion, and therefore a careful analysis of the provisions of all by the engineering profession is warranted. The three bills agree in providing $15,000 annually to each state and territory for the purpose of promoting engineering research, etc., and in stipulating some form of federal control over the moneys spent. Outside of these features, the three bills differ from one another in some details. According to the Newlands bill, the engineering research station in each state would be connected with the land grant college; the Smith-Howard bill provides that the station may be connected with any state-supported engineering school or university designated by the legislature, whereas the Gronna bill specifies that laboratories, equipment and individuals of any institution of learning or research may be utilized as opportunity presents. The Gronna bill would also create a state board of research appointed by a national research board, while the other two bills provide for local supervision and authority. There are undoubtedly arguments in favor of all these plans, but since they are mutually exclusive it becomes the duty of the engineering profession to weigh them carefully to determine which best meets the needs of the profession and then to lay its unanimous opinion before Congress at an opportune time.

## Nikola Tesla

THE award of the Edison medal to Nikola Tesla is most appropriate, in view of the early contribution that he made to alternating-current motors. In order to recognize that contribution, one must go back to the period, thirty years ago, when alternating-current engineering was greatly handicapped by the absence of motors capable of being installed on alternating-current circuits. Direct-current motors were well advanced, and there were many of them, particularly in America; but, except for synchronous single-phase motors and a few small series motors, the alternating-current motor was unknown. The synchronous motor was impracticable, because it had to be started and brought up to speed. Alternating current was used only for lighting. In the rivalry which then existed between the direct-current and alternating-current systems the former could claim to deliver both light and power, while the latter could deliver only light, although, with the aid of the transformer, it could do so at a relatively great economical distance.

It was at this point that Tesla invented the polyphase alternating-current system and polyphase motors, which, whether of the synchronous or of the asynchronous type, had the advantage of a definite starting torque. It is generally understood that he was not the only inventor of the polyphase motor. The same idea seems to have occurred to one or two other independent inventors in Europe. But not only was Tesla the sole American independent inventor of the polyphase motor, but he was also the only inventor of it in the whole world who had faith in it. He believed in it enthusiastically and urged its claims both publicly and privately. He built the first small polyphase motor, which behaved very satisfactorily, and he urged the building of larger ones. Much experimenting, designing and discarding had to be done before large polyphase motors could be built successfully, and the progress was slow; but Tesla's faith was unshakable and his claims were prophetic. A less enthusiastic nature might have quailed before the discouragements and have allowed success to escape.

The polyphase motor was not Tesla's only pioneer contribution to electrical progress. He was a tireless experimenter, and his experiments carried him very early into the field of high-frequency phenomena. He worked first with high-frequency alternators, or alternators

which, in 1890, were considered to give a high frequency. Later he developed the well-known Tesla induction coil, or high-frequency oscillator. With this new source he was able to demonstrate, during 1891 and 1892, in England, France and America, a number of entirely new electrical phenomena which at lower frequencies had previously been unobtainable. His lectures were given at the Royal Institution in London, the Franklin Institute in Philadelphia, and in various other places. The experimental phenomena he produced were dazzling and classical. They deservedly brought him great renown.

The high-frequency phenomena which Tesla first developed and displayed had scientific rather than practical interest; but Tesla called attention to the fact that by taking his electric oscillator, grounding one side of it and connecting the other to an insulated body of large surface, it should be possible to transmit electric oscillations to a great distance, and to communicate intelligence in this way to other oscillators in sympathetic resonance therewith. This was going far toward the invention of radio-telegraphy as we know it to-day.

For the above reasons we welcome and acclaim the award to Nikola Tesla which the American Institute of Electrical Engineers has made of its Edison medal. We of this generation are prone to forget the great efforts and the unwearying patience which have been necessary in the past to produce those results which are now the every-day electrical commonplaces of life, and it is well to signalize them, lest the next generation in its turn should forget the results of the pains and labor of this.

## Reflection Factors

IN PROBLEMS of illumination the reflection factors of the surfaces with which one has to deal rise to great importance. The measurement of these factors with reasonable precision is one of the serious tasks of the photometrist, since the eye alone gives a very imperfect idea of the facts of the case. We are glad therefore to publish a particularly useful discussion of the whole matter by M. Luckiesh. The facts he presents make very evident the necessity of its scientific study, and the discussion of methods will be very welcome to those who have to meet the problem in practice. The utter incapacity of the eye to judge reflection factors has been the cause of no small amount of unmistakably bad illumination. There is an enormous difference in reflectivity between things which are really white and those which seem to be almost the same thing. The least admixture of black, or red in particular, in painting a surface may change the reflection factor by 10 or 15 per cent. Certain "warm" grays, apparently very light, may show a factor of 40 per cent or so against 0.70 or better for a dead-white surface. We may casually note that reflection factors above 0.70 are extremely rare in paints. As Mr. Luckiesh notes, values of 0.8 or nearly that are obtainable, but small changes in the medium or the pigment, or changes due to the lapse of a very little time, may knock at least 10 per cent off this figure. The special interest of Mr. Luckiesh's paper lies in his study of the photometric methods used in the investigation of ordinary surfaces which possess both specular and diffuse reflection. No substance is perfectly diffusing, and on the other hand no material is wholly without diffusing power. Unless care be taken in selecting a proper photometric method very appreciable errors may be introduced in the results. The situation is still further complicated by the effect of colored light. The reflection factor of a given surface when illuminated respectively by the north sky and by an incandescent lamp may vary in the ratio of nearly three to two, so that diffusion that proved satisfactory in the one case would give scant help in the other. Aside from these practical matters, the characteristics of surfaces showing strong mixed reflection are of no small theoretical interest, the passage from diffuse to specular reflection involving some very delicate physical problems. Mr. Luckiesh's paper is therefore doubly welcome and will, we think, lead to a more careful and searching study of practical conditions of reflection.

## Progress in Prime Movers

THE abandonment of the regular convention of the National Electric Light Association will perhaps rather stimulate than diminish interest in the technical work done by the various committees. We always look forward with great interest to the report of the very able and industrious committee on prime movers, and this year's report shows no exception to the admirable record of the committee. It is difficult to pick out from this great and important mass of material those things which imperatively call for comment. At the present time the fundamental necessity is more than ever before the economical production of electrical energy, in other words raising the efficiency of generating units to the highest possible point. The onset of war conditions emphasizes with terrible force the need for fuel economy. Already it has become evident that owing to the combinations of interests which we in this country have learned all too patiently to tolerate the price of fuel to the central station and the householder alike is, without direct government interference, likely to rise to a practically prohibitive figure. The cost of coal to the consumer has shot up out of all possible sound economic relation to the conditions of supply.

The burden falls heavily everywhere, but on none quite so severely as on the central station operators, who of all those consuming fuel are the least able to recoup their losses by raising prices. The ordinary manufacturer who is hard hit promptly piles his troubles, plus 50 or 100 per cent, on the back of the consumer. The electric supply company, a public service institution under comparatively severe restraint, has not yet been able to transfer any part of its rapidly increasing burdens. Steps toward increase of efficiency in power generation are therefore of great importance, and those portions of the committee report which deal with lines of improvement are particularly interesting. More than anything else we are struck with the upward drift in the size of generating units and in the pressures and superheat employed. The committee report shows

that the average size of the turbo-generating units purchased during the past year is about 50 per cent greater than ever before. This increase is all along the line, from the biggest units to the smallest. In the former there is gain in overhead charges, in operating expense and to a small extent in efficiency, while in the smaller sizes, as is well known, the gain in efficiency is very rapid with increase of capacity. There is every possible reason for passing therefore to the larger units, even under circumstances which in ordinary times might make excess capacity of dubious value. With coal at the present prices and those likely to obtain within the next year, the economic situation changes very rapidly.

The same tendency has been displayed in the boiler and condenser units now employed. Five years ago the huge battery of boilers employed to feed one big steam turbine was so obvious a waste that it is almost impossible to see how it was tolerated even for a few years. No concession to commercial standardization was ever less justified, but time enforces lessons even on the unwilling, and to-day we find the boiler and condenser units somewhere near commensurate with the generators to which they are connected, a change which economically is thoroughly sound. Of even more interest is the very evident working toward higher pressure and superheat in steam plants. The normal pressure has thus far been limited chiefly by the normal standardized practice of boiler and piping manufacturers. It has been well understood that in going to very high pressures the costs of equipment would run immensely high. The small demand for pressures above 200 lb. to 250 lb. per square inch (14.1 kg. to 17.6 kg. per sq. cm.) has naturally discouraged development along these lines, so that everything for high pressure has been "special"—with all in the way of large prices, uncertain deliveries and difficult repairs which that word has come to imply. One cannot blame the boiler manufacturers for caution, but the penalization of special devices of all kinds in American practice is quite out of proportion to the actual needs of the case.

## Meter Testing

A BRIEF article by C. A. Mullen considers the work of meter testing in a large and scattered distribution plant. Few people outside the immediate field of electric metering have an adequate idea of the care and expense incurred in the maintenance and upkeep of even the best meters. In the practice of the Ohio company here considered the testing and repairing has for the sake of economy to be done in a central laboratory and repair shop for all the twenty towns served by the utility company. Even the smallest meters average a little over 30 cents expense for testing, while the larger ones may run to $2 or more. When complaints come in frequently, and they are in every station common enough about the time the yearly lighting load begins to increase, there is a very real and by no means negligible bill to be paid by the company before satisfaction is rendered. All in all, the electric meter is, considering the conditions of its service, a remarkably accurate and durable device, but it will not run indefinitely without care, and upkeep even under favorable conditions is no small affair. The cost can be kept down only by systematic care and thorough study of the conditions. Inasmuch as the meter is the most sensitive touchstone existing between the company and its patrons, it should be kept as accurate as possible, so that neither the public nor the company shall suffer loss.

## Failures in Underground Cables

IT IS generally recognized that of all the insulating materials known to man air is the cheapest when there is enough of it. The volume of air space that is utilized in the sense of being required for the insulation of a high-tension overhead three-phase transmission line is, however, so large that the cost of this air space is prohibitive in city districts. In cities it becomes absolutely necessary to cable all conductors and to place the cables or equivalent covered wires under ground. Consequently, as the land becomes built up and more densely populated, dependence has to be placed increasingly upon underground cables, leaving overhead wires to the open country. This means that more attention, care and maintenance have to be applied to high-tension cables year by year. The failure of such cables becomes a matter of increasing concern.

The causes of failure in underground cables are numerous when fully recited. They are dealt with in the article by Henry A. Cozzens, Jr., which we print this week. If we attempt to divide them into those due to carelessness on the one hand and those beyond control on the other, we may find that some of the causes are not easily fitted into either group. It is evident, however, that where sufficient care and study are devoted to the maintenance of underground cables their failures may be relatively rare. Underground cable installation, testing, repairs and maintenance form a business by themselves.

## The Coming Issues

WHILE the theft of energy is not so prevalent as to make the resulting loss to a central station very large in proportion to its income, it is sufficiently common to necessitate definite steps being taken to apprehend the wrongdoers and to prevent such petty larceny as far as possible. In the next issue of the ELECTRICAL WORLD will be outlined many of the methods now being successfully employed in different localities to safeguard the light and power business against the theft of electrical energy. There will be described also a new development in street-lighting units whereby the better qualities of refractor and diffusing globe units are combined. In addition there will be the regular departments devoted to broad commercial policy, operating practice and trade conditions, with the regular prices on jobbers' supplies. In the first issue of June there will be published a number of articles which will be of unusual interest from the standpoint of public policy.

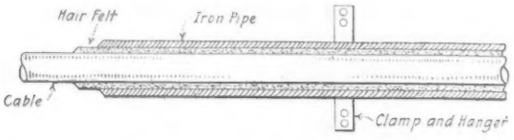
# Some Causes of Underground Cable Failure

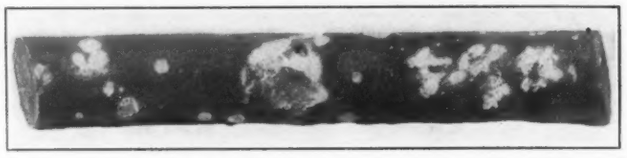
## Where to Look for the Usual Sources of Trouble and Suggestions for Remedies—Effect of Mechanical Injuries, Cable Heating, Electrolysis, Dielectric Depreciation, Etc.

BY HENRY A. COZZENS, JR.

WHILE placing wires underground largely eliminates the failures familiar with overhead construction, it does not remove all interruptions from distribution systems. However, the number of failures in underground systems is less than in overhead circuits provided that the installations have been made in accordance with the best practice and the most careful workmanship.

There are no parallel cases in overhead and underground failures. With the overhead lines the failures are due chiefly to external conditions, such as the weather, and possibly to the materials used, such as faulty insulators and other equipment. With underground circuits the cause of failure is primarily faulty insulation, which is brought about by numerous conditions either external or within the cable. The faults may be divided into mechanical failures, or those caused by influences external to the cable, and electrical failures, or those which occur in the cable owing to the load or electrical phenomena on the lines. Many times during the work of reconstructing conduit lines, when the cables are of necessity unprotected, picks, shovels and other tools are driven through the sheaths, injuring the cable and at times causing burn-outs immediately. In lowering duct lines a severe strain is placed upon the cables which may cause failures.



FIGS. 1 AND 2—USE OF HAIR FELT FOR PROTECTING CABLE AT SUPPORT; CABLE SHEATH DAMAGED BY ELECTROLYSIS

When cables are trained in the manholes, if the bends where the cable leaves the duct line and follows around the wall are made too sharp, many failures will result. In standard practice the manholes for transmission cables are either made oval or square corners are eliminated so as to do away with the necessity for sharp bends. For paper-insulated cables the bend should have not less than an 18-in. (45.7-cm.) radius. In the bending tests made on the cable at the factory the cable is bent over a drum having a diameter fifteen times that of the cable. A sharp bend in a loosely wound cable will often cause the conductors to shift with respect to each other and thus change the value of the insulation resistance between conductors or to the ground, making each bend a weak spot.

If sharp bends are made at the mouth of a duct, the contraction and expansion of the cable may cause rubbing at this point, thus wearing away the sheath. Longer radius bends and the use of duct protectors will eliminate this trouble. When cables are strung on elevated structures the vibration caused by cars may result in the cables rubbing against the insulators or columns, gradually wearing away the sheath and outer insulation. The vibration also tends to crystallize the metal and destroy the cable by this action.

Among the mechanical failures, those caused by a burn-out in one cable being communicated to the others may be mentioned. The arc caused by a short circuit will generate an enormous amount of heat, which will often fuse the duct materials and extend to the other cables, causing great damage. Recently numerous methods for protecting cables in the manholes have been devised, and they successfully demonstrate that a burn-out may now be isolated to one cable, so manhole fires can be largely eliminated. The use of the balanced-relay systems with split-conductor cables and such devices as the arcing-ground suppressor have reduced the burning interval of arcs to such a low figure that the chance for damage is greatly lessened.

Cable heating may be ascribed to two sources—one internal, due to the load carried on the cable, and the other external, due to outside influence. Failures resulting from external overheating would fall into the mechanical class. Overheating of this nature is usually caused by the proximity of steam lines to heavily loaded duct lines. This condition is most often revealed in congested districts or in the neighborhood of power stations.

Usually not much attention has been given to steam lines crossing under duct lines, particularly when they are well insulated. In one instance a small steam line feeding an outlying building passed under a conduit line heavily loaded with transmission feeders. The steam line was insulated with cork, which in turn was covered with concrete in the neighborhood of the crossing. After the line had been in use for some time without any adverse conditions developing, one cable suddenly failed and several others followed in quick succession. When it was attempted to remove the cables it was found that several were securely held in the ducts. It was then necessary to break the conduit line and rebuild it with split duct at the point of failure. Dismantling the conduit line showed that the fiber duct had caved in owing to the heat and curled up in the idle ducts. In some of the ducts occupied by the cables the duct had fallen down and securely held the cable, making the removal impossible. The only remedy in such cases is to remove the steam lines where possible or to place them above the duct line and near the surface.

Failures due to electrolysis are partly electrical and partly mechanical. These failures present a peculiarly difficult problem in that they do not appear un-

til some time after the electrolytic damage has been done. The only efficient way to eliminate failures due to electrolysis is to make periodic surveys in each locality and to eliminate at once any conditions which will tend to cause current which may be on the sheaths to pass to the ground directly. In many cases it will be found that a cable is badly pitted at frequent intervals, showing apparently that the current left the sheath at joints in the tile duct. The pittings permit moisture to enter the insulation, thereby reducing the value of the dielectric resistance until the leakage becomes large enough to cause the ultimate breakdown of the cable. Cases have been reported in which cables installed on hillsides have become so corroded that the compound has drained out of the insulation through the holes in the sheath and caused failure. These instances illustrate the necessity of constant attention to electrolytic conditions and also the importance of a careful examination of the sheaths of all cables withdrawn from duct lines.

The failures which may be classed as electrical are due chiefly to the decreased dielectric strength of the insulation. This decrease may be gradual, as when caused by the aging of the cable, or it may develop suddenly, as when caused by surges or the like. Where a transmission line consists of both overhead and underground sections, lightning may cause a surge, or switching changes may result in the building up of a high voltage and frequency which will instantaneously puncture the insulation and result in a failure. Present-day protective equipment has made the transmission line much less liable to failure by surges.

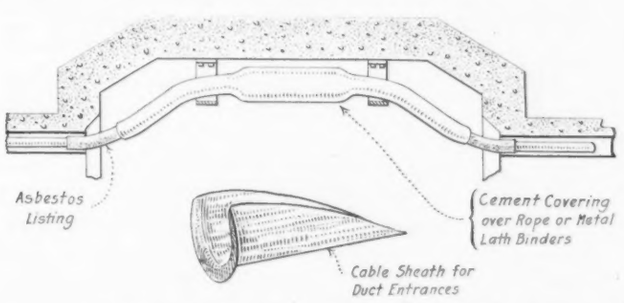
Faults due to manufacture sometimes cause failures after the cable has been installed, even though it has satisfactorily passed tests at the factory. Such failures are freakish and are not often encountered in the routine operation of cables. In one instance a cable had been tested at the factory and was later installed. Almost immediately a failure occurred, and examination showed that foreign matter in the form of a tag had become entangled in the paper during the fabrication of the cable. When the cable was coiled upon the reel this tag in no way reduced the dielectric strength, but when the cable was straightened out by installing it the insulation was weakened owing to the presence of the metal tag and failure resulted. On the other hand, cables have been known to stand up under operating conditions when more freakish conditions than this existed. In one instance a cable operated at 13,000 volts for several years with a tenpenny nail driven into the cable.

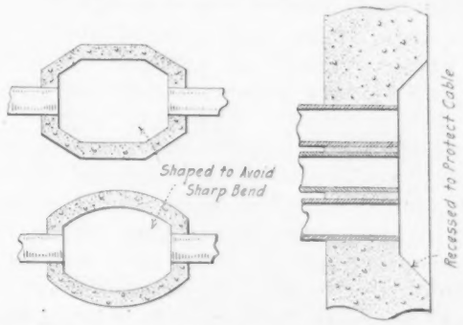
The primary cause of insulation failures in cables is the action of the heat generated in the conductors because of the copper and dielectric losses. The recent abnormal demand for service by industrial concerns, together with the shortage and high prices of the materials used in the manufacture of cables, has resulted in a considerable study of the rating of cables. This investigation will tend to bring out the factors attending the heating of cables and the relation of loading to safe operation. Formerly it was the practice to rate cables according to the area of the conductor and with no regard to the heat-dissipating characteristics of the duct lines or of the cables themselves.

Recent developments have shown that before ratings are decided a careful study should be made of the conditions under which the cable is to operate and a series of ratings should be established for individual cables under strictly local conditions. The lack of this development in the past has contributed largely to the majority of cable failures.

The following example is indicative of past conditions: Assume that an underground cable has been installed between two stations but no tests have been made to determine the rating of the new cable. The current-carrying capacity has been based purely on the copper density, allowing about 1 amp. per 1000 circ. mils of cross-sectional area. As the cable is new, the correctness of the rating seems to be established since heavy overloads may be carried with apparent safety. As time goes by, additional cables are installed to meet the increasing load demands, but no changes are made in the ratings. No reductions have been made for the summer months, neither has any account been taken of the increasing number of cables in the conduit line. Such conditions as these may continue for a number of years.

At some time, however, a cable in some manhole may be reported as being hot. The first thought that comes to mind is that the load is excessive, but investigation shows it to be normal. Inspection will often reveal the fact that the cable sheaths are warm in one manhole and normally moderate in temperature in those adjacent. Cable in this state will ultimately fail. When the sections are junked and examined the paper will generally be found to be practically free from all compound, resembling thickly oiled paper. From this evidence an explanation for the failures may be deduced. The heat generated by the losses due to the load has caused the compound to leave the high spots in the loosely wound paper cable and to flow to the low spots, or to leave the cable through holes in the sheath. Cases are known in which the sheath has been split open by this action. Since the insulation resistance depends upon the compound the paper retains more than upon the thickness of the paper, it is obvious that as the compound leaves certain sections of the cable these sec-




FIGS. 3 AND 4—METHOD OF FIREPROOFING CABLE IN MANHOLE; ARRANGEMENT TO AVOID DAMAGING CABLES ON SHARP CORNERS

tions will have a greatly decreased dielectric strength. The reduction in the resistance of the insulation will also permit the passage of leakage currents from the conductors to the sheath through the paper. The heat which is a function of the $I^2R$ losses will increase as the currents grow larger. If this action takes place over several years, the cable finally becomes "baked out" and the failures are but a question of time.

The foregoing case is an extreme one, but it actually happens and serves to show the effect of overloading cables. Under the new methods of placing ratings, a series of temperature tests would establish a relation between sheath, manhole and outside air temperatures for various load conditions. Thus the effect of installing additional cables should be evident, and the ratings could be altered accordingly.

Another class of electrical failures includes those which occur in the joints. The chief cause of joint failures is faulty workmanship on the part of the splicer. The splices are often made under adverse conditions of cramped space and under atmospheric conditions which are much more detrimental to the insulating of the cable than those which would be encountered in the factory. This class of failures may be considerably reduced by the employment of first-class splicers. Very reliable men are engaged in this class of work. The use of standard specifications and individual packages containing the exact amount of the proper materials for each type of joint has eliminated to a large degree the joint failure and has made the joint the strongest part of the cable.

Possibly no item bears as much relation toward the proper analyzing of cable failures as the maintenance of suitable records. Various companies have adopted standard forms which are filled out following a cable failure and which comprise a record of the conditions existing at the time of the failure and give on the reverse side a story of the methods used in locating and repairing the fault. Many times the correct cause cannot be assigned at the moment, but the data given will be a great aid in an investigation. These forms when filed will give a historical record of the cable.

# Measurement of Reflection Factor

## Importance of Knowing Coefficient of Reflection, Conditions Which Make Its Determination Difficult, and How Some of These Obstacles May Be Overcome

BY M. LUCKIESH

Nela Research Laboratory, Nela Park, Cleveland, Ohio.

THE necessity for determinations of reflection factor[1] is not hypothetical; it really exists. Data on this subject are of use in lighting and therefore are of interest in connection with wall-papers, paints and other materials. The covering power of paints can be determined by ascertaining the reflection factor. The influence of solvents, varnishes, etc., can also be determined in this manner. For example, after an ordinary yellowish board had been painted with two and three coats of dull-white high-purity paint it showed reflection factors of 0.77 and 0.80 respectively by the method described later in connection with Fig. 5. After the paint mixture had been changed so that one-sixth of the volume of each coat consisted of boiled linseed oil the factors were reduced to 0.74 and 0.77 respectively. This reduction is due both to the yellow color of the oil and to the decrease in the concentration of the pigment. Varnish possessing a yellowish tint reduces the reflection factor of a white painted surface very appreciably, sometimes as much as 10 per cent for fairly high-grade varnish. Many other uses for data on reflection factors are found by persons interested in the physics of pigments, light, etc. It is hoped that some attention will be given to this subject and that an agreement as to method will result. In the absence of a standardized method of measurement for reflection factor it is advisable to specify all conditions of measurement. For general measurements the writer has concluded to use the methods illustrated in Figs. 4 and 5 except in special cases. In these methods the specimens are illuminated diffusely from light sources of uniform brightness subtending approximately 180 deg. solid angles. Therefore they receive luminous flux from sources of minimum brightness per unit of illumination.

The chief elements which make the measurement of reflection factor difficult and even uncertain are: (1) the character of the reflecting surface; (2) the location of the source of illumination; (3) the solid-angular extent of the light source; (4) the spectral character of the illuminant; (5) the method of photometry. The last two elements are of interest only with colored surfaces, but they are almost always encountered in the measurement of reflection factor. It is the object of the following discussion to show the influence of these and various factors which make such measurements uncertain.

Different kinds of reflecting surfaces that are met in practice are represented in Fig. 1. The widely different characteristics shown make it difficult to standardize a method of measuring reflection factor or even to develop one that will be universally acceptable and equitable. Whenever possible it is advantageous to have a diagram available which will permit a graphic comparison of certain characteristics of objects or of certain data so that the relations may be readily visualized. This has been difficult to do with respect to reflection factor, but in Fig. 2 is shown a scheme for representing surfaces exhibiting either diffuse or specular reflection or both.[2] The diagram is satisfactory for surfaces the reflection from which does not depart too far from the perfect types of reflection. It is based upon the definition of reflection factor given by the Illuminating Engineering Society, which reads, "the ratio of the total luminous flux reflected by a surface to the total luminous flux incident upon it." It appears

[1] "Reflection factor" is used in place of "coefficient of reflection" to conform with the recent recommendation of the Illuminating Engineering Society.

[2] M. Luckiesh, "Light and Shade," 1916, page 19.

to the writer that this definition would be more generally useful if the word "total" were eliminated, because the definition could then be used universally.

### EFFECT OF LOCATION OF LIGHT SOURCE

Usually the measurement of reflection factor involves the measurement of the brightness of the specimen relative to that of a standard surface having a known reflection factor. For illustration consider that an ordinary brightness photometer is being used for this purpose. If $L$ in the left-hand diagram of Fig. 3 represents the position of a small source of light and $P$ that of the brightness photometer, determinations of diffuse reflection factors can be made by means of brightness measurements under known illumination intensities with a fair degree of accuracy if the reflecting characteristics of the surfaces approximate perfectly diffuse reflection. As the position of $P$ varies, the results change somewhat relatively to each other if the approximation to diffuse reflection is not sufficiently close. Although the accuracy of this method is sufficient for many practical purposes, it cannot be accepted in the general case as a precision method.

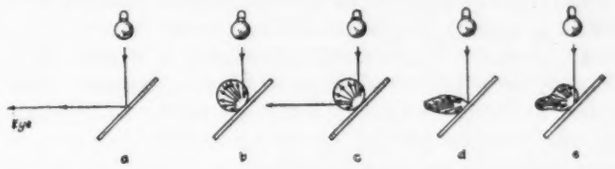



FIG. 1—CHIEF REFLECTING CHARACTERISTICS ENCOUNTERED IN PRACTICE

Regular or specular reflection, *a*, is exhibited by a mirror such as polished silver or a plain glass surface. No perfect diffusely reflecting surfaces are encountered. However, this type of reflection, *b*, is exhibited fairly well by dry white powder such as zinc oxide and magnesium sulphate or by blotting paper. Some glazed surfaces exhibit these two kinds of reflection simultaneously almost as perfectly as represented in *c*. An excellent example of this character can be made by placing a thin sheet of clear glass upon a sheet of blotting paper. By varying the reflection factor of the latter or by superposing smoked glasses of various densities various proportions of the two kinds of reflection—specular and diffuse—can be obtained. Sand-blasted glass and metallic surfaces, also gilded and "aluminized" surfaces, exhibit a spread reflection such as *d*. Calendered white paper and some varnished surfaces exhibit a combination of approximate diffuse and specular reflection represented by *e*.

If this diffusely reflecting surface is assumed to have a glazed or varnished coating, another difficulty arises. It is obvious that if the photometer $P$ and the small light source $L$ occupy positions as shown in the right-hand diagram of Fig. 3, the photometer will measure not only the brightness due to diffuse reflection but also that due to specular reflection. If the glazed surface is fairly plane optically, the brightness as viewed under this condition will depend partially upon the brightness of the light source because a brightness due to the reflected image of the light source is superposed on the "diffuse" brightness and no true measurement of the diffuse reflection factor is obtained. In fact, the diffuse brightness depends upon the illumination of the surface, or the flux density, and the "specular" brightness is really the brightness of the image of the light source, which depends upon the intrinsic brightness of the light source. Determined by method $f$ (Fig. 3), the reflectivity will evidently be somewhat less for a glaze-coated diffusely reflecting surface than for the same surface without the glazed coating. Various attempts were made to determine this difference by varnishing one of two identical diffusely reflecting gray surfaces, but difficulties were encountered which introduced uncertainties. Grays were experimented with because the effect of the glazed surface is more predominant than with surfaces having high reflection factors. Of course, the varnish coating alters the original reflecting characteristic, which made it advisable to abandon these experiments without attempting to overcome other difficulties. The effect can be demonstrated by superposing a thin sheet of clear glass on a diffusely reflecting surface, although, optically, this condition is not the same as that resulting from varnishing or otherwise polishing the surface.

### EFFECT OF SOLID-ANGULAR EXTENT OF LIGHT SOURCE

In the Nutting reflectometer[3], which is an ingenious and very satisfactory instrument for considerable practical work of this character and even for precision measurements of diffuse reflection factor, the specularly reflected image of the light source (a diffusing plate of ground opal glass) enters in the measurements in the case of a glazed surface. However, for ordinary surfaces, such as wall-papers and varnished and flat pigments, this factor is often negligible in practice. The theory of this instrument has been presented by Nutting. The optical paths into the photometer from surfaces $D$ and $S$ are shown in Fig. 4. It may be seen that the specularly reflected image of the light source does not escape the photometer as is indicated by the broken line. A difference of 4 per cent has been found between the reflection factor of a glazed white cardboard determined by this method and that shown in $f$ (Fig. 3). Inasmuch as there are various factors to consider and as the object of this study was not to establish precision measurements but to make a general survey, this difference can be considered only as the order of magnitude of the difference. However, for many ordinary surfaces, the differences in the results obtained by these two methods, which involve extremely different distributions of luminous flux, are very small. Where the accuracy can be within a few per cent of perfect these two methods may be considered to give

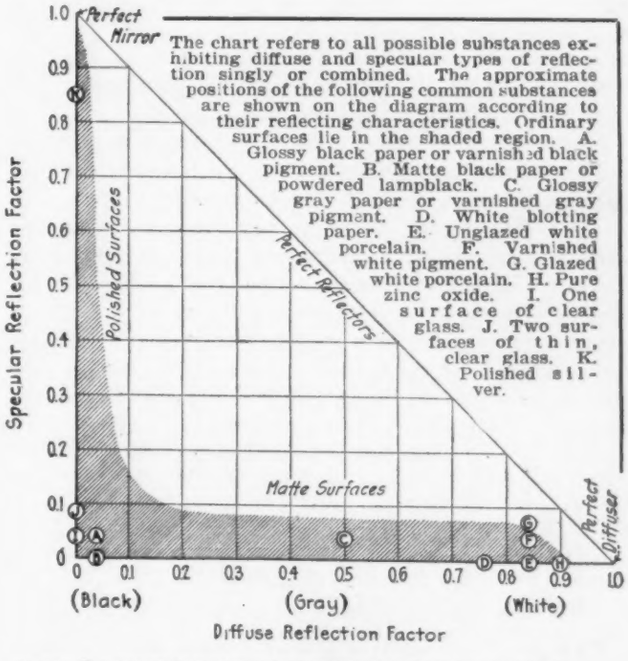

Perfect Mirror
The chart refers to all possible substances exhibiting diffuse and specular types of reflection singly or combined. The approximate positions of the following common substances are shown on the diagram according to their reflecting characteristics. Ordinary surfaces lie in the shaded region. A. Glossy black paper or varnished black pigment. B. Matte black paper or powdered lampblack. C. Glossy gray paper or varnished gray pigment. D. White blotting paper. E. Unglazed white porcelain. F. Varnished white pigment. G. Glazed white porcelain. H. Pure zinc oxide. I. One surface of clear glass. J. Two surfaces of thin, clear glass. K. Polished silver.
Polished Surfaces
Perfect Reflectors
Matte Surfaces
Perfect Diffuser
Specular Reflection Factor
Diffuse Reflection Factor
(Black)
(Gray)
(White)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

FIG. 2—DIAGRAMMATIC REPRESENTATION OF REFLECTION FACTORS

[3]P. G. Nutting, *Transactions I.E.S.*, Vol. VII, 1912, page 412.

approximately the same results for surfaces reflecting a greatly predominant portion of the light diffusely.

### Simple Method Employing Diffuse Illumination

From a practical viewpoint it appears, in general, to be more equitable to determine reflection factors under diffuse illumination. The simple apparatus required for this purpose can be readily made (see Fig. 5). With a standard diffusely reflecting surface available, determinations of reflection factor can be made with the apparatus shown by inserting a brightness photometer in hole *H* and comparing the brightness of the standard and specimen under constant illumination. One precaution is necessary, namely, the diaphragm must not be quite horizontal, or the hole must not be vertically over the orifice in *D;* otherwise a reflected image of the photometer tube and hole *H* will be observed on viewing glazed surfaces. It is obvious that the diaphragm *D* must be very thin, or light coming to the specimen in nearly a horizontal direction must be eliminated; otherwise the edge of the opening in the diaphragm will cast a shadow. An opal glass hemisphere used in a similar manner is satisfactory. It appears to the writer that this simple method has certain practical advantages for ordinary work that allows the use of an ordinary portable photometer and permits illuminating the specimen diffusely.

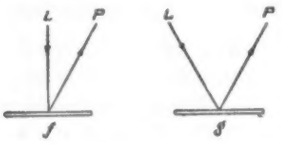



FIG. 3—EFFECT OF RELATIVE POSITIONS OF LIGHT SOURCE AND PHOTOMETER

Photometer *P* measures only the diffusely reflected light with the arrangement shown in *f* and both the specularly and diffusely reflected light with arrangement *g*.

Numerous measurements have been made to compare these methods, but the object was not to study the precision attainable, so that few data will be given. In general, for fairly diffusely reflecting surfaces the various methods of measurement gave approximately the same results (within a few per cent) when the reflection factors were greater than 0.4 or 0.5. Using a white blotting paper as a standard in each case, the results obtained for the reflection factor of a polished opal glass by methods *f* (Fig. 3), Fig. 4 and Fig. 5 were respectively 0.57, 0.56 and 0.54. For gray surfaces having reflection factors as low as 0.2 the differences were considerably greater, but it was not certain that these surfaces (which were painted) were uniform. An extreme case which illustrates the influence of a glazed surface involved a calendered black cardboard. The reflection factor determined by the method illustrated in Fig. 5 was about twice as large as that determined by method *f* (Fig. 3). Owing to polarization the result obtained with such a specimen by means of the instrument devised by Nutting is considerably in error. This error can be eliminated by using a photometric attachment which does not possess polarizers, for these are not a basic part of Nutting's suggestion.

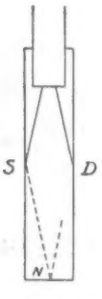



FIG. 4—OPTICAL PATHS IN NUTTING REFLECTOMETER

This instrument involves two infinite planes—one the light source *D* and the other surface *S*, the reflection factor of which is to be determined. The planes are made approximately infinite by the highly reflecting inner surface of the ring *N*, which for practical purposes is made of polished nickel. The distribution of luminous flux represents approximately diffuse illumination. Another method of considering the flux is to assume that surface *S* receives nearly a maximum amount of luminous flux per unit of area from a light source of nearly minimum brightness.

Although it appears that other methods than those using the integrating sphere will serve the practical requirements of reflection-factor measurements, when used properly and described completely, the sphere should be considered in precision measurements and in a study for the purpose of standardizing a method. The use of a sphere can be modified in many ways, but a simple method consists of illuminating a surface *S* (Fig. 6) by means of a powerful beam of luminous flux *B* and of determining the reflection factor by measuring the relative amount of luminous flux reflected as compared with that reflected from a surface having a known reflection factor. The comparison may be made by means of relative-brightness measurements of a diffusing glass attached to the photometer *P*, which is in the shadow of *S*. If the inner surface of the sphere possesses a high reflection factor, an approach to diffuse illumination is obtained. The question of the angle of the surface *S* is one to be settled before such a method becomes a standard.

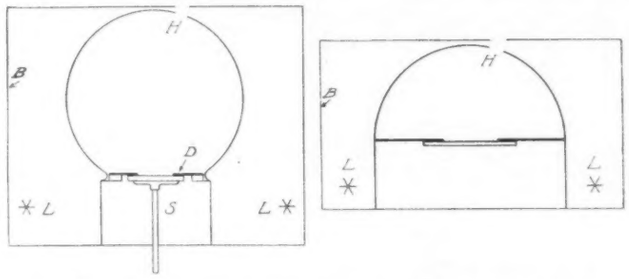



FIG. 5—SIMPLE APPARATUS FOR MEASURING REFLECTION FACTOR UNDER DIFFUSE ILLUMINATION

An opal glass globe, such as is used in lighting fixtures, is mounted inside a box *B* on a wooden standard surrounded by four or more light sources *L* located symmetrically. The box is painted white inside. Secured to the bottom of the globe is a thin opaque diaphragm *D* with a central orifice. The specimens to be tested are pressed against the under side of this orifice by means of the adjustable stand *S*. Holes *H* are provided in the box and globe so that a brightness photometer may be inserted therein and the reflection factor of any specimen determined under this practically perfect diffuse illumination by comparing its brightness with that of a standard diffusely reflecting surface. An opal-glass hemisphere like that shown at the right of Fig. 5 may be used in a similar manner.

Mathematical optical theory affords little help at present in determining reflection factors since it applies only to perfectly diffuse and specular reflection. Doubtless it could be applied to perfect spread reflection and therefore to combinations of specular, diffuse and spread reflection, but such applications would be too laborious and uncertain for general work.

### Effect of Spectral Character of Illuminant

Occasionally there appear data on the reflection factors of colored surfaces with no attendant descriptions of the spectral character of the illuminant or of the method of photometry and with no indication of the influence of these factors. These factors are vitally important in such determinations. Only for perfect diffusely reflecting neutral surfaces is the reflection factor invariable regardless of any condition of quality or distribution of luminous flux. The general neutral surface has a reflection factor which depends upon the distribution of illumination and upon other factors already described. Owing to the unsettled condition of the subject color-photometry, it may be said that it is impossible to state what the reflection factors of colored

surfaces are. However, as has been indicated in the preceding text, other elements involved in the measurements of reflection factor are also quite as unsettled.

To illustrate the influence of the spectral character of an illuminant upon the reflection factors of colored surfaces, determinations were made under the illumination obtained with an overcast sky and under that obtained with a tungsten lamp operating at 7.9 lumens per watt.[4] A few of the results are given in Table I. The ratios of the reflection factor for tungsten light to that for skylight are presented in the last column. These measurements were made by an experienced observer by means of the direct-comparison method. The

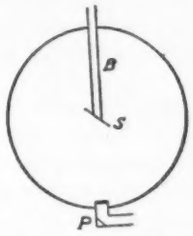



FIG. 6—INTEGRATING SPHERE MODIFIED FOR DETERMINING REFLECTION FACTOR

A beam of light flux $B$ is incident on surface $S$. The reflection factor of $S$ is determined in terms of a standard by means of photometer $P$ by the method of substitution.

results are comparable as relative values notwithstanding the possible unacceptability of the method of photometry. At least, the data show the folly of reporting the reflection factors of colored surfaces without including the conditions under which the tests were made.

### EFFECT OF METHOD OF PHOTOMETRY

Notwithstanding the excellent work which has been done on the problem of color-photometry, no method has yet been accepted universally for the photometry of colored brightnesses such as are encountered in general in the measurement of reflection factor. The direct-comparison and flicker methods yield different results in extreme color-difference photometry, so that the choice of a method is of importance here. The author has found that the ratio of a red to a green brightness may differ, by these two methods, by as much as nearly 100 per cent. This difference can be reduced by restricting the size of the photometric field and by other precautions. However, the outstanding difference is considerable as indicated in Table II. In this table the ratios of the value determined by the direct-comparison method to that obtained by the flicker method are presented in the last column. These determinations were made under the approved conditions of fairly small photometric field and moderately high illumination intensity. They show that the method of photometry is an important factor. These data should only be considered as showing the magnitude of the differences obtained by the two methods. Apparently the relative values change with various conditions of illumination and field size in various ways not readily predicted or explained at present.

### SOME OPTICAL CHARACTERISTICS OF SURFACES

The reflection from ordinary media is a combination or the conglomerate result of many individual reflections and refractions from minute surfaces. The individual particles, fibers, surfaces, etc., may be quite transparent, yet as a whole the surface may reflect light diffusely. A piece of glass may be transparent but when ground into a powder it appears white or diffusely reflecting. A white blotting paper made up of minute translucent fibers separated by air spaces reflects diffusely owing to myriads of reflections and refractions which break up the wave front and eventually send rays back in all directions. Such a surface reflects ordinarily about 0.75 of the incident luminous flux. However, when saturated with water the surface appears gray by contrast with the dry specimen because the reflection factor is now reduced to about 0.5. In the latter case the air spaces have been replaced by water of higher refractive index than air, and as a consequence the amount of luminous flux reflected at each surface is considerably reduced and the substance has become more transparent, as is readily seen. In a similar manner varnish changes the reflecting characteristic of a surface, and colored surfaces when varnished sometimes appear of a purer color.

TABLE I—EFFECT OF SPECTRAL CHARACTER OF LIGHT ON REFLECTION FACTOR OF COLORED SURFACES

| Color of Reflecting Surface | Reflection Factor | | Ratio |
|---|---|---|---|
| | Overcast Sky | Tungsten Lamp | |
| White | 0.75 | 0.75 | 1.00 |
| Red-purple | 0.16 | 0.23 | 1.44 |
| Red | 0.21 | 0.31 | 1.48 |
| Orange | 0.38 | 0.48 | 1.26 |
| Yellow | 0.60 | 0.65 | 1.08 |
| Green | 0.32 | 0.24 | 0.75 |
| Blue | 0.13 | 0.09 | 0.69 |
| Violet | 0.14 | 0.12 | 0.86 |

A glazed colored surface reflects two components—one, specularly, from the surface, which is in most cases practically unchanged in quality or spectral character, and another, more or less diffusely, which has been altered in spectral character owing to the selective absorption of the pigment. Some metals—for example gold—appear decidedly colored even at the critical angle of specular reflection, and many other surfaces exhibit a variation in color near this critical angle. Interference phenomena sometimes cause changes in color with variations in the angle of incidence. These most interesting aspects of reflection and of colors are touched upon to show how intricate the reflection of radiant energy is and as a consequence the measurement of reflection factor.

TABLE II—RELATIVE BRIGHTNESSES OF DIFFUSELY REFLECTING COLORED SURFACES UNDER CONSTANT ILLUMINATION (BY THE TWO METHODS)

| Color of Illuminated Surface | Relative Brightness | | |
|---|---|---|---|
| | Flicker ($a$) | Direct Comparison ($b$) | Ratio ($b/a$) |
| White | 0.75 | 0.75 | 1.00 |
| Red | 0.13 | 0.12 | 0.92 |
| Orange | 0.26 | 0.23 | 0.88 |
| Yellow | 0.59 | 0.59 | 1.00 |
| Green | 0.31 | 0.36 | 1.16 |
| Blue | 0.21 | 0.22 | 1.05 |

The author acknowledges the assistance of H. H. Kirby in obtaining the data and making the illustrations for this paper.

[4] M. Luckiesh, "Color and Its Applications," 1915, page 168.

# Characteristics of Standard Inclosed Fuses—II

## Results of an Investigation of Suitable Construction Materials, Performance of Fuses Under Different Operating Conditions, and Effect of Size, Kind and Amount of Filler on Operation

BY WALTER ARTHUR

COMPARATIVE ratings of standard inclosed fuses made of different metals, and the effect of the shape of the fusible element and the amount, character and size of the filler pellets on the sensitiveness of the fuses, were subjects discussed on page 456 of the March 10 issue of the ELECTRICAL WORLD. In this article, which concludes the subject of characteristics of

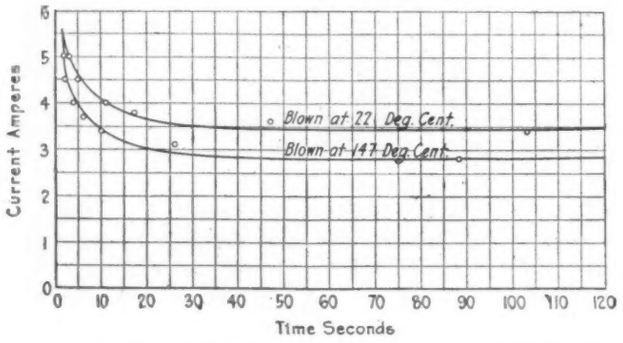



FIG. 3—CURVES SHOWING EFFECT OF INITIAL TEMPERATURE ON TIME OF FUSE BLOWING

standard inclosed fuses, are taken up the effect of length, diameter and heat conductivity of the fuse case, location of the fusible element, temperature of surrounding air, initial temperature, indicator wires, etc. Considerations necessary in testing fuses are also pointed out in this article.

The heat conductivity of the inclosing case has an influence on the time-blowing of fuses, but no data are at hand to enable the determination of the relative conductances of cases of different materials. It is obvious, however, that a wholly metal or porcelain case would conduct heat more rapidly than fiber cases. A greater conductance would tend to increase any errors due to this cause. The same may be said to be true of heat capacity.

The length and diameter of the fuse case is of considerable significance in so far that there is a certain minimum length and diameter beyond which we can go without materially affecting the results. At the same time there is a certain maximum length and diameter beyond which we cannot hope to go and improve the results. The regularity of the time-blowing is influenced by the length of the case, by the conductance of the heat along the fusible element to the caps on the ends of the case; and this is never the same in any two fuses. The greater the length of the case the less this influence. On a very short fuse the case often becomes quite hot with a current which would easily be normal for the rating on a longer fuse.

### LOCATION OF THE FUSIBLE ELEMENT

The location of the fusible element in the filler is one of the very important factors which influence to large extent the regularity of the operation of fuses. If this element be in the center of the filler or is equally insulated on all sides, the irregularities from the heat losses are not noticeable, except those occurring by conduction of heat through the fusible element to the caps on the ends. If, however, the fusible element is not equally insulated on all sides, a greater loss of heat will occur than in those fuses having the elements correctly located. This loss increases the time of blowing under any given load.

If the fusible element be very near the wall of the case, that side will become very much hotter than the other. And if the fuse be of several amperes, the fiber case may be charred or even burned. To insure regularity of operation the fusible element should be equally insulated on all sides, which is usually the case if it be in the center of the filler and the filler be equally settled down on all sides.

### EFFECT OF TEMPERATURE OF THE SURROUNDING ATMOSPHERE

The flow of heat from one point to another is quite dependent upon and directly proportional to the difference in temperature between the two points, as may be seen from the formula,

$$W = \frac{(T - t)A}{RL}$$

where $W$ = watts of heat flowing, $T$ = temperature of the hotter side, $t$ = the temperature of the cooler side, $A$ = cross-section of area transmitting the heat, $R$ = resistivity of the insulating material, and $L$ = thickness of insulation. This formula is applicable to the behavior of fuses when blown at different temperatures. The higher the temperature the sooner will the fusible element reach its melting point and be blown. The influence of this factor would be appreciable in a few

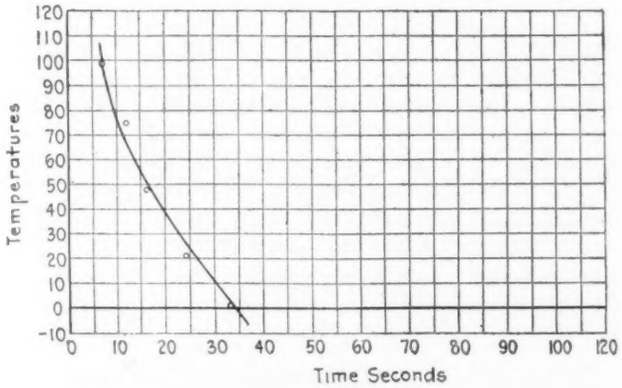



FIG. 4—CURVE SHOWING THE EFFECT OF INITIAL TEMPERATURE ON TIME OF BLOWING FUSES WHEN USING A CONSTANT CURRENT OF 3.7 AMP.

instances. In case a fuse was placed in an atmosphere subject to a wide range of temperature it would change its rating to a considerable extent. With changes which ordinarily occur in a shop or factory it would not be appreciable.

In Fig. 3 the effect of blowing two sets of fuses,

made exactly alike, at two different temperatures is shown. The first one was blown at room temperature (22 deg. C.) and the second at 147 deg. C. The curves show in graphic form the relative changes produced by this change in temperature. The change of 125 deg. C. caused a lowering of the rating of about 0.5 amp. on a 3-amp. fuse. The curves are not different in shape but parallel throughout. Fig. 4 illustrates the behavior of fuses when blown with the same current of 3.7 amp. but at different temperatures.

TABLE VI—FUSES MADE IN THE FACTORY WHICH SHOW THE EFFECT OF INDICATOR WIRES ON THE BLOWING POINT

Wires—zinc; indicator wires—4-mil calorite; filler—pellet-lime, 10 per cent passing 20 mesh; cases—fiber, 0.5 in.x1 ⅛ in.; fuse rated as 4 amp.

| Without Indicator Wires | | | With Indicator Wires | | |
|---|---|---|---|---|---|
| Current in Amp. | Time in Sec. | Average Time | Current in Amp. | Time in Sec. | Average Time |
| 7.0 | 2 | 3 | 7.0 | 5 | 4 |
| | 4 | | | 4 | |
| 6.5 | 7 | 10 | 6.5 | 11 | 22 |
| | 10 | | | 30 | |
| | 9 | | | 25 | |
| | 15 | | | | |
| | | | 6.3 | 125 | 45 |
| 6.3 | 35 | 19 | | 28 | |
| | 30 | | | 5 | |
| | 15 | | | 37 | |
| | 7 | | | 30 | |
| | 7 | | | | |
| | | | 6.1 | 90 | 90 |
| 6.1 | 17 | 39 | | | |
| | 9 | | 6.0 | 53 | 84 |
| | 50 | | | 15 | |
| | 65 | | | 150 | |
| | 35 | | | 115 | |
| 6.0 | 45 | 55 | 5.5 | 450 | 450 |
| | 70 | | | | |
| | 55 | | | | |
| | 55 | | | | |
| | 50 | | | | |
| 5.5 | 300 | 240 | | | |
| | 240 | | | | |
| | 180 | | | | |

A fusible element made from a metal oxidizing at a temperature much below its melting point may have its rating very much changed by subjecting it to a heating at a high temperature before blowing. This is due of course to the change in the cross-section and the formation of a layer of oxide on the outside.

## Effect of Indicator Wires

In Table VI is shown the effect of indicator wires upon ordinary fuses made in the factory. These fuses had the pellet-lime filler and ordinary zinc wires. The normal rating of this fuse without the indicator wires was about 5 amp. When provided with 4-mil calorite wires for indicators an increase in rating of about 0.25 amp. was observed.

## Cadmium Ribbon Fuses

Table VII gives the time-blowing points of a number of cadmium ribbon fuses. These were made with the usual fiber cases and silicic acid filler. This so-called silicic acid filler is not properly silicic acid ($H_2SiO_3$) but silicic acid that has been dehydrated by the simple process of drying, leaving only $SiO_2$ which is silica. The silicic acid used in these fuses was obtained from Merck & Company of New York and is known as wet process silicic acid.

In filling the fuse case of 0.5 in. by 1 15/16 in. (1.27 cm. by 4.92 cm.) by pouring in the loose material and tapping it down to about two-thirds of its original volume, an average of about 0.778 gram is necessary. Table VIII gives the results of weighing the filler from twenty-one fuses made in the factory which had been filled with silicic acid in the ordinary manner. It will be noted that there are no great variations from the average, and these are not sufficient to cause any irregularity of the time-blowing points.

TABLE VII—SHOWING THE CARRYING CAPACITIES OF FUSES MADE FROM DIFFERENT SIZED CADMIUM RIBBONS

Filler—silicic acid; indicator wires—4-mil calorite; cases—fiber, 0.5 in.x1 ⅛in.

| 2x24-Mil Ribbon | | 2x38-Mil Ribbon | | 2x56-Mil Ribbon | |
|---|---|---|---|---|---|
| Current in Amp. | Time in Sec. | Current in Amp. | Time in Sec. | Current in Amp. | Time in Sec. |
| 3.5 | 3 | 5.5 | 2 | 6.5 | 3 |
| | 3 | | | | |
| | | | 4 | 6.0 | 5 |
| 3.2 | 3 | 5.0 | 4 | | 4 |
| | 4 | | | | |
| | | 4.5 | 7 | 5.5 | 9 |
| 3.0 | 6 | | 7 | | 8 |
| | 6 | | | | |
| | | 4.1 | 13 | 5.0 | 16 |
| 2.8 | 14 | | 17 | | 17 |
| | 13 | | 18 | | 18 |
| | 16 | | 11 | | |
| | | | | 4.8 | 20 |
| 2.7 | 29 | 3.8 | 28 | | 25 |
| | 24 | | 25 | | 19 |
| | 32 | | 25 | | 19 |
| | 27 | | 28 | | |
| | | | 25 | 4.6 | 28 |
| 2.6 | 28 | | | | 21 |
| | 33 | 3.6 | 40 | | 29 |
| | 35 | | 53 | | 30 |
| | 28 | | 45 | | 28 |
| | | | 65 | | |
| 2.5 | 96 | | 48 | 4.4 | 60 |
| | 76 | | | | 57 |
| | 80 | 3.5 | 60 | 4.2 | 47 |
| | | | 80 | | 54 |
| 2.4 | 145 | | 65 | | 150 |
| | 155 | | | | 84 |
| | 138 | 3.4 | 190 | | 113 |
| | 130 | | 120 | | 96 |
| | | | 180 | 4.0 | 185 |
| | | | 100 | | 155 |
| | | | 180 | | 113 |

## Testing of Fuses

The correct testing of fuses after they have been made is an exceedingly important matter. In order to get a correct idea of the rating of the fuse it must be tested over quite a range of currents, from the current which blows the fuse at a few seconds to the current which blows it in several minutes. In all of the data given the testing was done by placing the fuse in series with an ammeter and a variable resistance. After properly adjusting the resistance the current was sent through the fuse, and by the means of a stop-clock reading to seconds the time necessary to open the circuit was noted. By making several "blowings" at each current tried and getting an average time, most of the errors and irregularities which might come in were eliminated. In all of the curves given the points were obtained from averages of several blowings.

TABLE VIII—WEIGHTS OF SILICIC ACID FILLER ORDINARILY TAPPED INTO FUSES, ¼-IN. INTERNAL DIAMETER AND 1¼-IN. LENGTH

Filler was weighed after the fuses were blown, but free from pieces of metal. (Fuses were of zinc ribbon 2x50 mils.)

| | Weight in Grams | | Weight in Grams |
|---|---|---|---|
| First fuse | 0.810 | Twelfth fuse | 0.760 |
| Second fuse | 0.710 | Thirteenth fuse | 0.820 |
| Third fuse | 0.750 | Fourteenth fuse | 0.730 |
| Fourth fuse | 0.791 | Fifteenth fuse | 0.765 |
| Fifth fuse | 0.770 | Sixteenth fuse | 0.780 |
| Sixth fuse | 0.769 | Seventeenth fuse | 0.766 |
| Seventh fuse | 0.796 | Eighteenth fuse | 0.834 |
| Eighth fuse | 0.820 | Nineteenth fuse | 0.766 |
| Ninth fuse | 0.765 | Twentieth fuse | 0.768 |
| Tenth fuse | 0.876 | Twenty-first fuse | 0.767 |
| Eleventh fuse | 0.730 | | |

Average, 0.774. Extremes, 0.86 0.710

# TESTING METERS ON OHIO SYSTEM

## Method of Work Employed, System of Keeping Records Used and Cost Involved

BY C. A. MULLEN

Testing meters on the Ohio Service Company's system presents quite a different problem from that experienced by the average central-station company because at the present time twenty towns along 85 miles of transmission lines are being served, the largest number of meters in any one town being around 1200. A laboratory and repair shop is maintained in the general office building at Coshocton for testing and repairing all ordinary electrical equipment used by the company.

New meters are shipped from the manufacturers direct to the laboratory, where they are tested and numbered serially regardless of the towns, districts or routes in which they will eventually come to be installed. Ten meters are tested in series, a 110-volt load up to

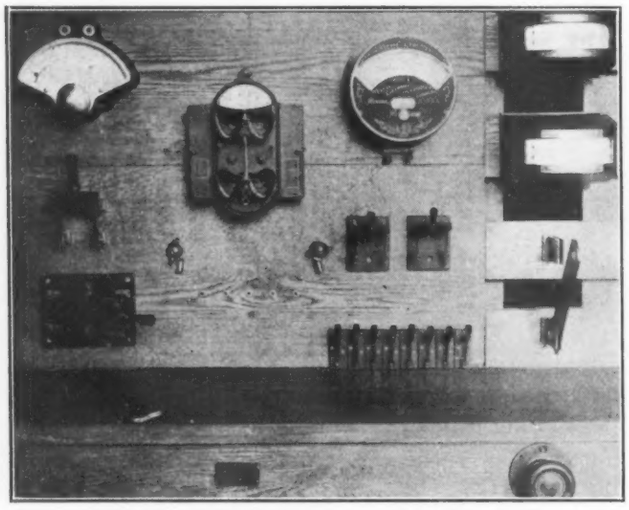


FIG. 1—TESTING BENCH FOR METERS RATED ABOVE 25 AMP. RANGE OF CURRENT 0 AMP. TO 600 AMP.

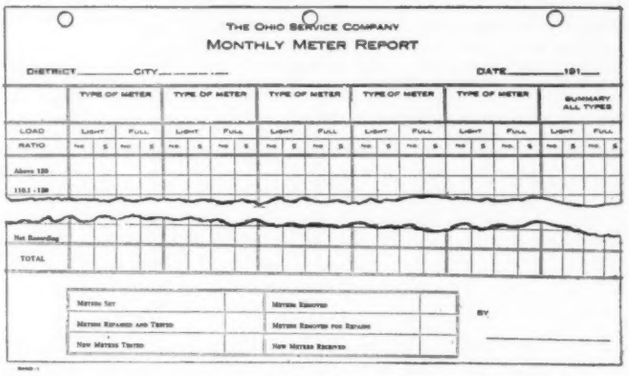
25 amp. being provided. The average cost of unpacking, testing, numbering and repacking the meters is $8.42 a hundred. The cost of packing varies considerably with different makes of meters. For testing meters above 25 amp. rating the type of bench shown above is used. Loads from zero to 600 amp. are obtained by a low-voltage loading transformer.

Each district office is provided with a voltmeter, a

METER ACCURACIES OBSERVED

| Per Cent Accuracy | Per Cent of Meters Tested: Light Load | Full Load |
|---|---|---|
| Over 120 | 0.04 | 0.04 |
| 110-120 | 0.15 | 0.55 |
| 104-110 | 0.59 | 1.10 |
| 102-104 | 4.00 | 5.00 |
| 98-102 | 71.00 | 82.00 |
| 96- 98 | 8.50 | 6.10 |
| 90- 96 | 5.40 | 2.46 |
| 80- 90 | 3.60 | 1.60 |
| Below 80 | 5.22 | 0.92 |
| Not recording | 1.50 | 0.23 |

rotating standard and a phantom loading device, other instruments being obtained from the laboratory when needed. It is, of course, out of the question to keep a meter-man in each town, so a lineman, or whoever is most available in that particular office, is employed to read, install and test meters in connection with answering complaints. Periodic tests are conducted by experienced meter-men whose headquarters are at the laboratory. When on regular work, or when remaining in one town a week or more, these men pay their own


THE OHIO SERVICE COMPANY
MONTHLY METER REPORT

DISTRICT_____CITY_____DATE_____191__

| | TYPE OF METER | TYPE OF METER | TYPE OF METER | TYPE OF METER | TYPE OF METER | SUMMARY ALL TYPES |
|---|---|---|---|---|---|---|
| LOAD | Light / Full | Light / Full | Light / Full | Light / Full | Light / Full | Light / Full |
| RATIO | No. / S | No. / S | No. / S | No. / S | No. / S | No. / S |
| Above 120 | | | | | | |
| 110.1 - 120 | | | | | | |
| Not Recording | | | | | | |
| TOTAL | | | | | | |

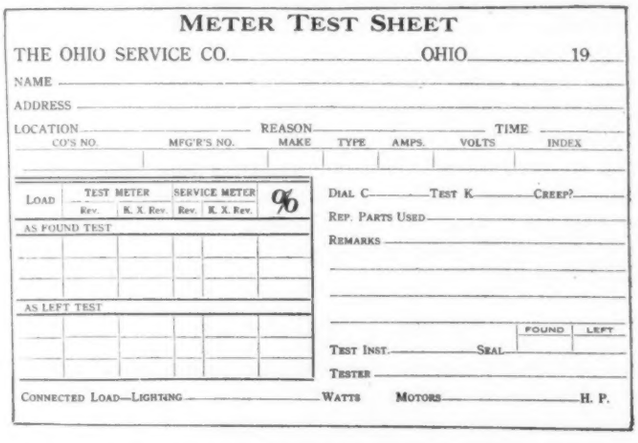
| | |
|---|---|
| Meters Set | Meters Removed |
| Meters Removed and Tested | Meters Removed for Repairs |
| New Meters Tested | New Meters Received |

BY _____

FIG. 2—MONTHLY METER REPORT USED BY EACH DISTRICT

expenses except railroad fare. No installation tests are made on small meters, but on power meters of 50 kw. or more a test and inspection of the meter and connections is made immediately by the testing department. Periodic testing is carried on as follows: Residence meters, every three years; commercial and small power meters, once a year; meters rated at 50 kw. or over, every three months; switchboard meters, every three months. For convenience a 110-volt load is used in testing service meters up to 25 amp. rating. For larger sizes a portable phantom load is used. The table herewith gives the result of testing about 5000 meters for the first time, showing the percentage of total number of meters tested in the class between 110 and 120 per cent, 104 and 110, 102 and 104, etc.

The average cost of testing residential, commercial and small power meters is 30.45 cents each. This includes all charges except interest and depreciation of


METER TEST SHEET

THE OHIO SERVICE CO._____OHIO_____19__

NAME _____

ADDRESS _____

LOCATION_____REASON_____TIME _____

| CO'S NO. | MFG'R'S NO. | MAKE | TYPE | AMPS. | VOLTS | INDEX |
|---|---|---|---|---|---|---|
| | | | | | | |

| LOAD | TEST METER: Rev. | TEST METER: K. X. Rev. | SERVICE METER: Rev. | SERVICE METER: K. X. Rev. | % |
|---|---|---|---|---|---|---|
| AS FOUND TEST | | | | | |
| | | | | | |
| | | | | | |
| AS LEFT TEST | | | | | |
| | | | | | |
| | | | | | |

DIAL C_____TEST K_____CREEP?_____

REP. PARTS USED _____

REMARKS _____

| | FOUND | LEFT |
|---|---|---|
| TEST INST. | | |
| SEAL | | |
| TESTER | | |

CONNECTED LOAD—LIGHTING_____WATTS MOTORS_____H. P.

FIG. 3—FORM USED AS A REPORT OF TEST ON SERVICE METERS

testing equipment. The cost of testing large power meters is $2.08 each. This charge includes railroad fare, automobile and hotel expenses of the tester.

The Ohio Service Company has found it necessary to use several forms to save time, and to keep its records in proper condition. For outside testing the form shown in Fig. 3 is used. This is made in duplicate,

the original being kept by the district superintendent, and the data on the copy transferred to the meter record card. On one side of the meter record card is space for six test records. The other side is devoted to data taken from the name plate of the meter, its location, and information regarding removals. A brief report is made at the end of the week on a special form, and at the close of the month the meter tests are separated, classified, and the results made into the form of the monthly report shown in Fig. 2.

For the calculation of demands another form is used. As this test requires the inspector to remain on the premises all day, counting meter revolutions every two hours, he generally has about six hours to spare. This time is utilized in making a complete survey of the plant and its equipment, operating methods, number of employees, contemplated growth, change of machinery, etc., the data being written in narrative form.

A regular schedule of inspection is also carried on by this department. Insulation resistance tests, other outside resistance measurements, and oil and glove tests are made.

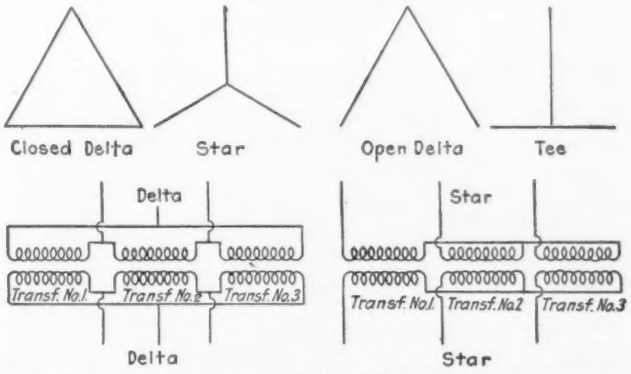
## THREE-PHASE CONNECTIONS

### Merits of Various Connections That Are Commonly Employed with Transformers

BY R. E. UPTEGRAFF

Four different three-phase transformer connections, shown sectionally herewith, are in common use. With the closed-delta and star connections four combinations of primary and secondaries are available—delta-delta, delta-star, star-delta and star-star.

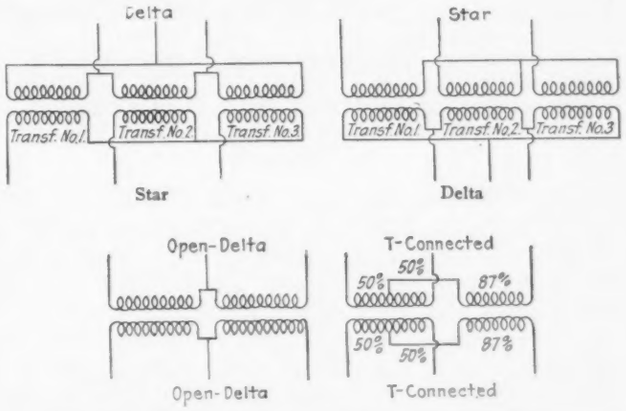
The delta-delta connection is most commonly used, first, because if one of the units become disabled the other two may be used in open-delta at 57.7 per cent of the original rating of the bank, thus avoiding a complete shutdown. Also with unbalancing of the load better balancing of voltage will be maintained than in any of the other combinations, because the phases are connected so they will help each other. Again, if the impedances of the transformer are slightly different, then each transformer will share the load according to




FOUR TYPES OF CONNECTIONS AND TRANSFORMERS CONNECTED IN DELTA-DELTA AND STAR-STAR

its impedance in order that the voltage in all phases shall be alike. If, however, one of the transformers is slightly off ratio or if a third harmonic exists in the wave form of the supply circuit a useless or circulating current will flow around the windings. The amount of this current will depend on the impedance of the transformers and the magnitude of the third harmonic or amount of off ratio, as the case may be. This current, of course, heats the windings and does no good.

The star-delta and delta-star combinations are used chiefly where it is desired to step up to a high-voltage principally for transmission, the star connection being used for the high-voltage winding and the delta connection for the low-voltage winding. As is generally




DELTA-STAR, STAR-DELTA, OPEN-DELTA AND T CONNECTIONS

known, the voltage of each transformer for star connection is only 57.7 per cent of the line voltage; therefore if the neutral point is grounded the whole system will have a ground stress of only 57.7 per cent of the line voltage. As a result lighter insulation can be used for transformer parts and also for the line, thus permitting cheaper construction. The grounded neutral in the star connection allows a third harmonic current to flow over the lines and between neutral points, which is undesirable.

The star-star connection is seldom used owing to the fact that the neutral points can shift, thus throwing a higher voltage than normal on one transformer. Furthermore, a short-circuit could occur on one of the transformers which would cause a rise of voltage (as much as 173 per cent of normal) in the other two that might burn them out in a short time. The star-star connection has one advantage, however, in that transformers of different design or make can be operated together, the only possible harm due to difference in impedance or ratio being a slight unbalancing in voltage.

The open-delta and T connections have but one advantage, this being that only two units are required for three-phase transformation. The open-delta connection has the disadvantage of poorer regulation on one phase than on the other two. There is also a relative loss in transformer capacity. For example, if $E$ is line volts and $I$ the line current, then the three-phase power is $EI\sqrt{3} = 1.73\,EI$. Since the voltage in each transformer is $E$ and the current $I$, then the total available single-phase capacity is $2\,EI$, but the three-phase capacity is $1.73\,EI$ or a difference of $0.27\,EI$ or 15.5 per cent less.

The T connection has the disadvantage of having different amounts of windings in the two transformers, that is, 86.6 per cent in one and 100 per cent in other, with the 86.6 per cent winding connected to the middle point of the 100 per cent winding. Furthermore, the windings on the 100 per cent transformer must be interlaced in order that unbalancing shall not occur. Special transformers are therefore required, which is not desirable. The T connection also loses 7.3 per cent in capacity since the available single-phase capacity is $1.866\,EI$ and the three phase $1.73\,EI$.

# STATION AND OPERATING PRACTICE

*A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy*

## CAUSES OF MEGGER TROUBLES

### Locomotive Smoke Mixed with Dew Causes Low Reading—Trouble in Megger Remedied by Cleaning

Some difficulty was experienced recently on a line of the Southern Wisconsin Power Company in trying to test insulators in the morning when there was a heavy dew or when there was a heavy frost. Under these conditions none of the insulators appeared to have more than 500 megohms resistance, and the needle of the megger would never come to rest but would constantly move back and forth over a range of 50 megohms. This action, it was pointed out recently by G. C. Neff, Prairie du Sac, Wis., in a paper read to the Madison branch of the A. I. E. E., is probably due to the fact that the line parallels a railroad and the smoke from the locomotives causes a deposit to form on the insulator which, when moistened with water, forms a conductor. No trouble was found in testing insulators immediately after a summer shower, for this apparently washed the insulator clean.

When the line was about half tested the megger failed to operate properly, not more than 200 megohms being indicated on open circuit. The trouble was found to be caused by carbon and copper dust which had been worn from the brushes and collector rings and had formed a high-resistance circuit inside the megger. The trouble was removed by cleaning.

While the testing of insulators with a megger is a simple operation, Mr. Neff concludes it is very important that the man in charge of the testing party should be wide awake, have considerable electrical knowledge and have good judgment, otherwise many good insulators may be condemned.

## PROVIDING COMMUTATING POLES

### Necessity of Making Allowances When Incorporating New Features of Design into an Existing Old Machine

BY E. C. PARHAM

Where the clearances are such as to permit it, non-commutating-pole machines may be converted into commutating-pole machines, but the proposition is considerably simplified if the mechanic or the engineer who is doing the job has a quantitative idea of what he is doing. The owner of a machine shop had for a long time been driving his shop shafting by means of a commutating-pole motor that had given absolutely no trouble. The capacity of his shop was becoming too small, so he decided to get another motor and to divide the work between them. He bought a second-hand motor of the same size and of the same general type as the motor that he had, but the second-hand motor had no commutating poles. As its connected load included a heavy grindstone, there was some sparking when starting, so the owner decided to convert the motor into a commutating-pole machine.

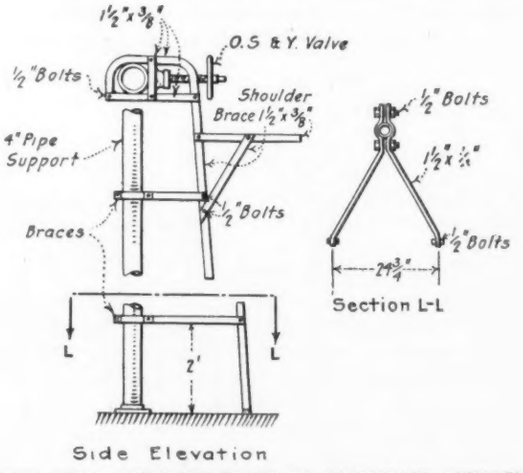
He disassembled one of the commutating poles of the older machine, measured the dimensions of the pole pieces as well as the number of turns and size of wire of the winding, and noted the manner of machining the frame to receive the pole pieces. The job was carefully executed, but after everything was installed and connected sparkless commutation could not be obtained. An expert who was then called in determined that increasing or decreasing the number of turns on the commutating poles effected no improvement. The desired results were obtained by shimming the commutating pole pieces 1/32 in. (0.79 mm.).

## PROVIDING ACCESS TO VALVES

### Construction of Ladder Equipped with Shoulder Brace Which Facilitates Operation of Large Valves

BY T. W. REYNOLDS

Where an overhead valve must be operated frequently or emergency access thereto is important it is advisable to provide a fixed iron ladder equipped similar to the one shown in the accompanying sketch. The shoulder brace is an advantage and a necessity where valves of large size are to be quickly opened or shut. The piping at the valve should be carried on an adjustable pipe support secured to the floor by a bolted flange and to the




LADDER WITH SHOULDER BRACE TO FACILITATE OPERATING OVERHEAD VALVES

pipe by a ½-in. (1.27-cm.) bolt. The sides of the ladder and its shoulder brace may be made of 1½-in. by ⅜-in. (3.8-cm. by 9.5-mm.) wrought iron and the rungs of ¾-in. (1.9-cm.) rods, 24 in. (60.9 cm.) long, on 15-in. (38.1-cm.) centers. The ladder and shoulder straps should be well braced and bolted and ample radius should be provided for the shoulders

## COST OF LINE MATERIALS

### Data of Interest Recently Compiled by a Small Massachusetts Company

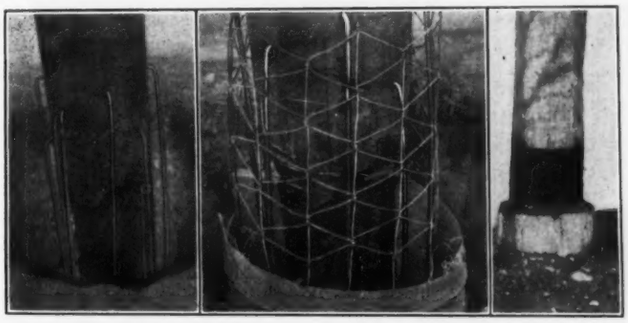
From data recently prepared by the Amesbury (Mass.) Electric Light Company covering 13,200-volt line material costs since Jan. 1, 1917, the following extracts are printed. The figures reflect the present high levels of equipment prices among small companies. Besides being interesting in connection with making estimates they have record value:

| Quantity | Items | Cost |
|---|---|---|
| 158 | 30-ft. poles, chestnut, B | $726.80 |
| 24 | 35-ft. poles, chestnut, B | 146.40 |
| 20 | 40-ft. poles, chestnut, B | 165.00 |
| 8 | 45-ft. poles, chestnut, B | 88.00 |
| 8 | 50-ft. poles, chestnut, B | 136.00 |
| 287 | 2-pin cross-arms (special) | 172.20 |
| 4 | 4-pin cross-arms | 5.00 |
| 8 | 8-pin cross-arms | 17.20 |
| 15,223 lb. | No. 2 bare H. D. copper wire | 5,147.04 |
| 373 lb. | No. 4 bare S. D. copper wire | 137.67 |
| 381 lb. | No. 2 bare stranded copper wire | 137.16 |
| 532 lb. | No. 2 W. P. wire | 146.83 |
| 500 ft. | ½-in. 7-strand guy wire | 7.50 |
| 5,250 ft. | 5/16-in. 7-strand guy wire | 89.62 |
| 850 ft. | 7/16-in. 7-strand guy wire | 15.45 |
| 50 | No. 58,160 line wire protectors | 209.87 |
| 100 | No. 2 copper splicing sleeves | 32.67 |
| 90 | 6-ft. anchor rods | 53.10 |
| 19 | Anchor planks | 7.60 |
| 356 ft. | 12-in. by 2-in. spruce planking | 15.24 |
| 10 gal. | Creosote | 6.00 |
| 4 | 600-kw., 13,200/2200-volt transformers | 7,550.00 |
| 6 | 300-amp., 13,200-volt choke coils | 229.50 |
| 2 | 3-phase, 13,200-volt lightning arresters | 752.00 |
| 6 | 300-amp. 13,200-volt disconnecting switches | 60.00 |
| Setting | 200 poles (by contract) | 3,770.00 |

## REINFORCING POLES

### Method and Cost of Reinforcing 259 Poles That Had Been in Service for Seventeen Years

Red-cedar poles which had been in service for nearly seventeen years were recently reinforced with concrete by the Puget Sound Traction, Light & Power Company. The line is 7 miles (4.2 km.) long and is a main power line serving the American Smelting & Refining Company's plant at Tacoma, Wash. The accompanying illustration shows how the reinforcing was placed around the pole. First the earth around the ground line was removed. Then iron rods with the ends bent at right angles were driven into the poles around the weakened section as shown and expanded-metal strips wrapped around the rods. After a piece of sheet metal had been placed inside the hole around the pole butt to serve as a form the concrete was poured. About seven rods were used on each pole. The cost of reinforcing the 259 poles on this line cost was $2,355.14, making the total cost per pole $9.10 and the material cost per pole $3.59. The table shown herewith gives the total and unit amount of each kind of material used, the total and unit cost thereof as well as the labor cost. K. C. Schluss is superintendent of power and equipment.



STEPS IN PROCESS OF REINFORCING POLE

COST OF REINFORCING 259 POLES WITH CONCRETE

| | Amount | Total Cost | Amount per Pole | Cost per Pole |
|---|---|---|---|---|
| Material: | | | | |
| No. 1 iron rods | 1575 | $362.25 | 6.1 | $1.40 |
| No. 2 iron rods | 443 | 126.92 | 1.7 | 0.49 |
| Expanded metal | 300 pieces | 63.60 | 1.16 pieces | 0.246 |
| Sand | 53 yd. | 78.23 | 0.205 yd. | 0.304 |
| Pea gravel | 99 yd. | 158.32 | 0.382 yd. | 0.612 |
| Cement | 474 sacks | 241.69 | 1.83 sacks | 0.933 |
| Tools, etc. | ..... | 160.38 | ..... | 0.633 |
| Labor: | | | | |
| Hauling (including rent of wagon) | ..... | 183.92 | ..... | 0.71 |
| Reinforcing | ..... | 931.81 | ..... | 3.59 |
| Moving poles | ..... | 12.90 | ..... | 0.05 |
| Guying | ..... | 10.94 | ..... | 0.042 |
| Cleaning up | ..... | 13.00 | ..... | 0.05 |
| Miscellaneous | ..... | 11.18 | ..... | 0.043 |
| Total | ..... | $2,355.14 | ..... | $9.10 |

## DETERMINING LOSSES IN IDENTICAL MACHINES

### Description of Method by Which an Auxiliary Machine Is Used as a Booster to Supply the Copper Losses

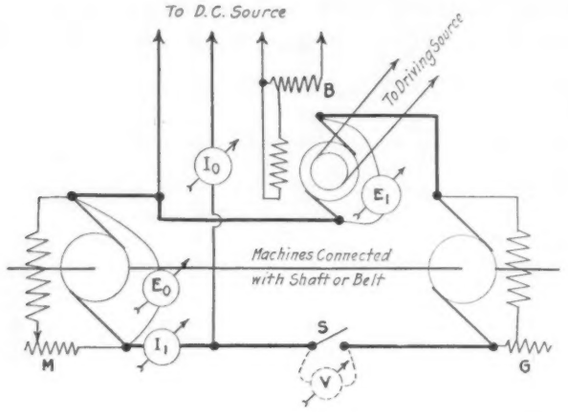
BY GUSTAV E. JANSSON

If the losses of two identical machines are to be measured, they can be determined in a very simple manner, provided that a third machine of ample current-carrying capacity to act as booster is available. The machines should be connected as shown in the accompanying diagram, using two voltmeters and ammeters. Switch $S$ is left open at the start, and the field rheostats $M$ and $G$ adjusted until the correct speed and voltage are obtained. The no-load power output equals $I_0E_0$. Neglecting the small copper losses, the iron and friction losses in each machine will be $W_0' = \frac{1}{2}W_0 = \frac{1}{2}E_0I_0$. Switch $S$ is now closed, taking care that the right polarity and potential are obtained. This is assured by connecting a voltmeter across the switch $S$ and adjusting the rheostat $G$ until the potential across the switch becomes zero. After the switch $S$ is closed rheostat $G$ should be adjusted until normal current is read at $I_1$. The booster should then be started and $G$ and $B$ regulated until $I_1$ = normal current + $I_0/2$. $I_0$ is kept constant so that only the no-load losses are supplied directly from the line while the copper losses are supplied by the booster. If the losses at different loads are wanted, $I_1$ is calculated from kw. $\times$ 1000/$E$ and regulated for this value + $\frac{1}{2}I_0$. $I_1$, $I_0$, $E_0$ and $E_1$ may then be read and recorded as is shown in the table herewith.

FORM OF TEST RECORD

| Load | $I_1+I_0/2$ Calcu. | $I_1$ Read | $I_0$ Read | $E_0$ Read | $I_2$ Calcu. | $E_1$ Read | $N$ Read | $Y$% Calcu. |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | .... | Constant | Constant | 0 | .... | Normal | .... |
| ¼ | .... | .... | .... | .... | .... | .... | Normal | .... |

It should be kept in mind that the rheostat $G$ must be regulated to keep the speed $N$ constant. $I_0$ must also be maintained constant, the booster supplying the copper losses. $W_c = E_1 I_2$ where $I_2 = I_1 - I_0$. Assuming that




CONNECTIONS EMPLOYED WHEN MEASURING MACHINE LOSSES

the armature resistance $R$ is equal in both machines ($W'_c = \frac{1}{2} \times W_c = \frac{1}{2} E_1 I_2$), then the efficiency $y$ in per cent equals $(I_1 \times E_0) \times 100 \div (I_1 \times E_0 + W'_c + W'_0)$.

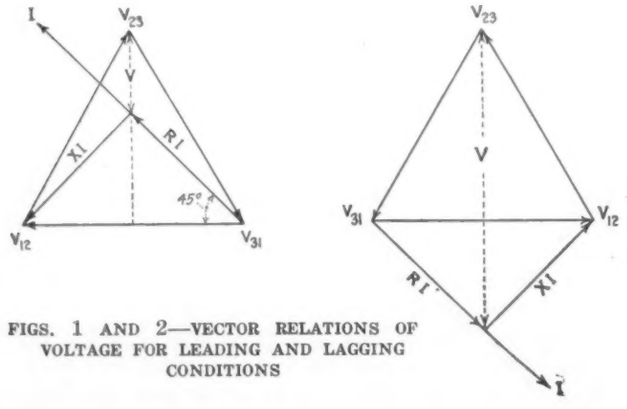
---

## DETERMINING PHASE ROTATION

### Resistors and Reactors Used with Voltmeters to Determine Rotation of Phase Vectors

BY W. V. LYON

For determining the phase rotation in a three-phase circuit, that is, to ascertain whether or not the line voltage between mains 1 and 2 leads or lags the voltage between mains 2 and 3, the writer has found the scheme shown in the accompanying illustrations useful and convenient. It consists of a non-inductive resistor and a low-resistance reactor of the same ohm value connected in series between two of the mains. The magnitude of the voltage between the third main and the junction of these two units indicates the phase rotation. Mark the mains 1, 2 and 3 as in Fig. 3. Connect the free terminal of the resistor to main 1 and the free terminal of the reactor to main 2. Measure the voltage from their junction to main 3. If this voltage




FIGS. 1 AND 2—VECTOR RELATIONS OF VOLTAGE FOR LEADING AND LAGGING CONDITIONS

is approximately 37 per cent of the line voltage, the voltage between mains 1 and 2 leads the voltage between mains 2 and 3. If the voltage is approximately 137 per cent of the line voltage, however, the voltage between mains 1 and 2 lags the voltage between mains 2 and 3.

The proof of this fact is simple. Refer to Figs. 1 and 2. Assume that the line voltages are equal. The interior angles of the voltage triangles are then 60 deg. Any ordinary unbalancing of the line voltages would affect the voltmeter reading but little. The current should be at least ten times as much as the voltmeter takes on full scale deflection. If this be the case the voltmeter will read not more than 2 per cent less than the stated values. In the proof it is assumed that the voltmeter current is negligibly small.

Let $V_{12}$ lead $V_{23}$ as shown in Fig. 1. If the resistor and reactor have the same resistance value in ohms, the current will lag the voltage from 1 to 2 by 45 deg. The voltmeter reading, $V$, will be

$$V = (0.866 - 0.50) \times \text{line voltage}$$
$$= 0.37 \times \text{line voltage.}$$

If $V_{12}$ lags $V_{23}$, as shown in Fig. 2, the voltmeter reading is

$$V = (0.866 + 0.50) \times \text{line voltage}$$
$$= 1.37 \times \text{line voltage.}$$

In order that the device may be used on circuits of

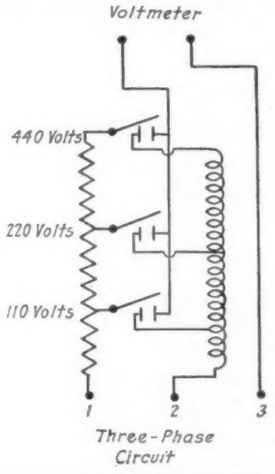



FIG. 3—CONNECTIONS OF RESISTOR, REACTOR AND VOLTMETER

different voltages switches should be provided as shown in Fig. 3. For example, when it is to be used on a 220-volt circuit the switch marked 220 volts should be closed and the other two left open. By properly choosing the ohm values of the units, the current may be kept constant and the same accuracy obtained at the different voltages without excessive heating loss.

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## Maintenance of Standby Equipment

According to Don D. Morgan, superintendent of generation and transmission for the Pacific Light & Power Corporation, considerable trouble is experienced because of leaky valves and flanges and corrosion of standby steam equipment. Trouble with superheaters has been eliminated to a considerable extent by providing drips from them to the regular drip system. Temperature variations and corrosion have been found to be the cause of the leaky pipes and valves. Emergency operation of reserve equipment is very inefficient, owing to the lack of experience of the men who are called in to work for only short periods at infrequent intervals.

# CENTRAL STATION SERVICE

*A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat*

## INCLUSION OF SWITCHES IN ADVERTISED WIRING PRICES

### Comparative Wealth of Communities or Districts Is Held to Be the Controlling Factor in This Connection

In a discussion before a recent convention Fred H. Scheel of Joliet, Ill., said that with his company local conditions govern the number of switches that are included in advertised prices of house wiring. In the poorer communities few if any switches are included in the flat price because it is desired to bring the advertised price down to the minimum point. In the high-class residence districts as many switches as possible are always included in the advertised price. In such cases it is usually the policy to include switches for the more important rooms in the house.

## PREDOMINATING CENTRAL STATION LAMP POLICY

### Answers to Questionnaire Sent Out by N. E. L. A. Lamp Committee Show Policies of Companies Grouped According to Number of Customers

This year's report of the lamp committee of the National Electric Light Association, Frank W. Smith chairman, reveals in addition to the regular statistics on lamp sales, developments in the manufacture and characteristics of incandescent lamps and recommendations, some very pertinent discussion on the continued use of carbon lamps, besides making a very important contribution in the form of a report on current practices in the merchandising and free renewals of incandescent lamps. The report is still in the hands of the committee, but it is expected that it will be ready for distribution in the near future.

In the matter of lamp policy the committee feels that it is incumbent upon it to again emphasize the importance of member companies keeping a close supervision over the supply of incandescent lamps to their customers, and repeats the statement made in previous reports, that so far as may be possible customers should be provided with full and complete information as to lamp development and that the highest grade of lamps it is possible to obtain be made available. From time to time a canvass has been made by the committee in order to present the methods followed by member companies in handling the lamp situation.

This year this work was undertaken by a sub-committee, and a presentation is made which is the result of that investigation. The aim has been to obtain full and complete information from member companies as to their exact practice, and with that thought in mind questionnaire blanks were sent to the entire Class A membership of the association.

Four hundred and forty-one replies were received, representing 40 per cent of the member companies. Replies were received from every state in the Union, a number from the Dominion of Canada, and one from the Territory of Alaska. The maximum number of replies from any one state was forty-two (New York), the

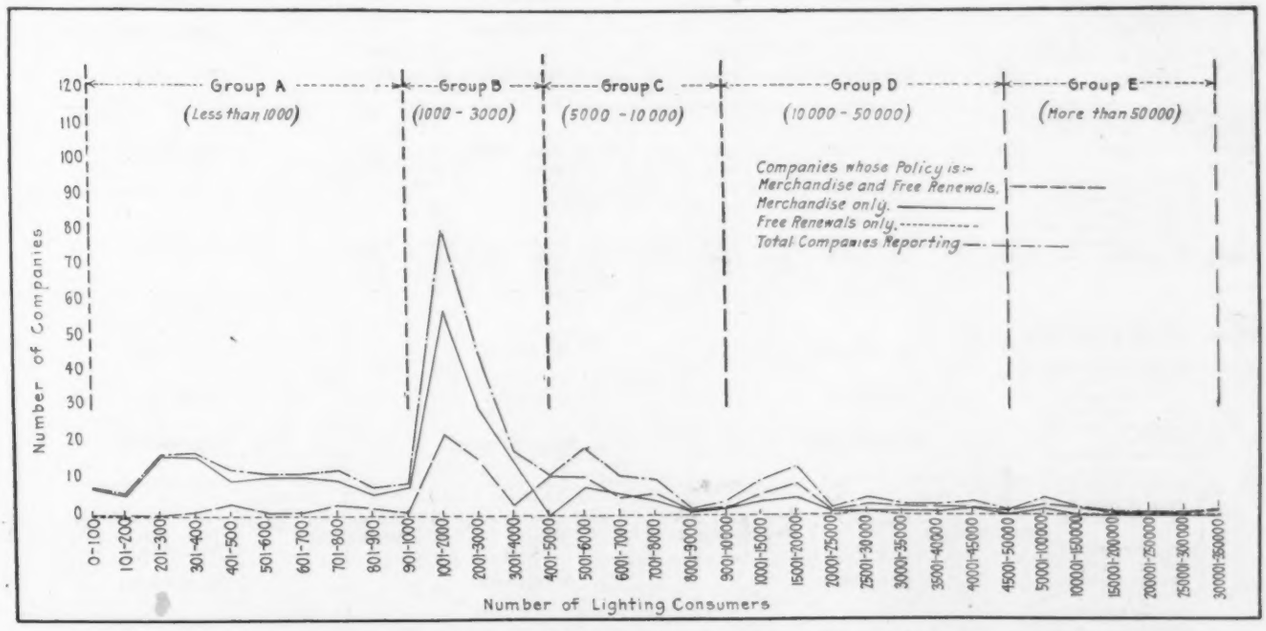


CHART SHOWING RELATIVE SIZES OF COMPANIES THAT REPLIED TO LAMP COMMITTEE QUESTIONNAIRE

Summary of replies according to company lamp policy: Free renewals only—A, 0; B, 0; C, 1; D, 1; E, 1; indeterminate, 0; total, 3. Merchandising only—A, 112; B, 116; C, 23; D, 16; E, 2; indeterminate, 0; total, 269. Free renewals and merchandising—A, 15; B, 56; C, 25; D, 28; E, 8; indeterminate, 0; total, 132. Do not handle lamps—A, 4; B, 12; C, 2; D, 3; E, 0; indeterminate, 13; total, 34. Give renewals and make lamp service charge—A, 0; B, 0; C, 0; D, 2; E, 2; indeterminate, 0; total, 4.

average per state eight, while seventeen states returned replies in excess of this average. It may therefore be assumed that any conclusions reached from the replies received are representative of the membership.

The replies were divided into four classes which were found, from the information furnished, to be the basic policies by which lamps are handled, namely, those companies which merchandise only, those which merchandise and furnish free renewals, those which furnish free renewals only, and those which do not handle lamps in any manner. The replies were then grouped under five subdivisions according to the number of lighting customers served—Group A, 1000 or less; Group B, 1001 to 5000; Group C, 5001 to 10,000; Group D, 10,001 to 50,000, and Group E, more than 50,000.

After a very detailed analysis of all replies received it was found possible to present the final answer in the form of a chart or table shown herewith, which is divided into three main divisions, namely, the merchandising policy of those companies which merchandise only, the merchandising policy of those companies which merchandise and furnish free renewals as well, and the free-renewal policy of those companies which merchandise and furnish free renewals.

Under each of these headings five subdivisions are shown similar to the grouping previously referred to as to number of lighting customers served. The policy and practice as represented by the majority of companies in each group was considered to be the predominating policy or practice within that group (number of lighting customers served). For example, assuming that it is desired to learn the predominating policy of those companies supplying 1000 lighting customers or fewer who merchandise only, it will be found that the majority merchandise Mazda lamps only, sell lamps at list prices, do not allow special discounts in event of quantity pur-

## CHART SHOWING PREDOMINATING LAMP POLICY OF CENTRAL STATIONS IN THE UNITED

| | | Merchandising Policy of those Companies which Merchandise Only | | | | | | Merchandising Policy of those Companies which Merchandise and Give Free Renewals | | | | | | Free Renewal Policy of those Companies which Merchandise and Give Free Renewals | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | See foot-note (*) | A | B | C | D | E | Total | A | B | C | D | E | Total | A | B | C | D | E | Total |
| General policy | Merchandise lamps | Yes | | | | | | Yes | | | | | | Not applicable | | | | | |
| | First installations free | Not applicable | | | | | | Not applicable | | | | | | No | | | | | |
| | Renewals free | Not applicable | | | | | | Not applicable | | | | | | Yes | | | | | |
| | Sell other lamps than those supplied free | Not applicable | | | | | | Not applicable | | | | | | Yes | | | | | |
| Kind of lamp or combination of kinds | Merchandised | Mazda | Mazda | Mazda | Mazda | Mazda | ϕ | Mazda and Gem | (a) | Mazda, Gem & Carbon | Mazda and Gem | Mazda, Gem & Carbon | Mazda and Gem | Not applicable | | | | | |
| | Supplied free on first installation | Not applicable | | | | | | Not applicable | | | | | | Gem | Gem | Gem | Gem | ϕ | Gem |
| | Supplied free on renewals | Not applicable | | | | | | Not applicable | | | | | | Gem | Gem | Gem | Gem | Mazda, Gem and Carbon | Gem |
| Prices of lamps | Merchandising prices | List | List | Below list | List | List | List | List | List | Below list | List | Below list | List | Not applicable | | | | | |
| | First installation prices | Not applicable | | | | | | Not applicable | | | | | | List | List | Below list | List | At cost | List |
| | Prices of lamps other than those supplied free | Not applicable | | | | | | Not applicable | | | | | | List | List | Below list | List | Below list | List |
| | Special prices for certain sizes of lamps | Not offered | | | | | | Not offered | | | | | | Not applicable | | | | | |
| | Credit for the return of old lamps or stubs | Not allowed | | | | | | Not allowed | | | | | | Not applicable | | | | | |
| | Special discounts in event of quantity purchases | Not allowed | Allowed | Allowed | Allowed | Allowed | Allowed | Not allowed | Allowed | Allowed | Allowed | Allowed | Allowed | Not applicable | | | | | |
| Guarantees and claims | Guarantees against defects in merchandised lamps | Not given | Not given | Not given | Given | Given | Not given | Not given | Given | Not given | Given | Not given | Not given | Not applicable | | | | | |
| | Claims for replacements of merchandised lamps on account of defects are recognized within | Reasonable time | Reasonable time | Reasonable time | Short life | Average life | Reasonable time | Ten days | Reasonable time | Reasonable time | Reasonable time | Reasonable time | Reasonable time | Not applicable | | | | | |
| Miscellaneous | Record of the average life of lamps supplied on free renewal | Not applicable | | | | | | Not applicable | | | | | | Not kept | | | | | |
| | Electrical supply stores, hardware stores, etc. in the community | Sell lamps | | | | | | Sell lamps | | | | | | Not applicable | | | | | |
| | Other electric lighting companies in the community | Do not sell lamps | | | | | | Do not sell lamps | | | | | | Do not sell lamps | | | | | |
| | Of all the lamps used by consumers in the community the company replying supplies approximately | 91–100% | 71–80% | 71–80% | 61–70% | 91–100% | Not obtainable | 91–100% | 71–80% | 91–100% | 81–90% | 91–100% | Not obtainable | 91–100% | 71–80% | 91–100% | 91–100% | 91–100% | Not obtainable |
| | Sales policy results in a | Gain | | | | | | Gain | | | | | | Not applicable | | | | | |
| | Inspection service of consumers' premises | Not applicable | | | | | | Not applicable | | | | | | Not maintained | | | | | |
| | Post-cards, etc., to be used for requests for inspection of installation or for renewals | Not applicable | | | | | | Not applicable | | | | | | Not provided | | | | | |

*A, 1000 or less; B, 1001 to 5000; C, 5001 to 10,000; D, 10,001 to 50,000; E, 50,001 or more. ϕImpossible to determine predominating policy. (a) Indeterminate:—Replies evenly divided between "Mazda and Gem" and "Mazda, Gem and Carbon." (b) Indeterminate:—Replies evenly divided between "Identification" and "No identification." (c) Indeterminate:—Replies evenly divided between "Over counter" and "Messenger and over counter." (d) Indeterminate—Replies evenly divided between "Electric" and "Gasoline." (e Indeterminate:—Replies

chases, do not give guarantees against defects, recognize claims for defects made within reasonable time, deliver over counter, also make deliveries by company's wagons (gas cars being used), provide no means of identification for delivery men, install lamps on customers' premises if requested of deliverymen, supply 91 to 100 per cent of all the lamps used by consumers in the community.

The information discloses among other details that 61 per cent of companies reporting merchandise only, that 31 per cent merchandise and furnish free renewals, four companies make a service charge for lamp installations and renewals, two supply free renewals only and do not merchandise or sell lamps. The remaining thirty-four companies do not handle lamps in any manner.

Of those companies merchandising and furnishing free renewals as well (31 per cent), twenty-three companies are still furnishing exclusively carbon lamps on first installation or renewal, and while the majority of these companies fall within the three groups supplying 10,000 lighting customers or fewer, eight are within the group supplying 10,001 to 50,000 customers.

With respect to the use of the Gem lamp in this group of 31 per cent supplying free lamp renewals and merchandising, eighty-three companies, or 60 per cent, are using this type of lamp for first installation or renewal, the larger part of which fall within the group supplying 10,000 customers or fewer, and by far the largest number within the group between 1000 and 5000 customers. There are, however, seventeen companies using this type of lamp within the group from 10,000 to 50,000 customers.

The point is emphasized that this chart is a résumé of the information at hand and under the several items of policy and practice gives the predominating methods as determined by the replies received.

## STATES AND CANADA, 1917, GROUPED ACCORDING TO NUMBER OF LIGHTING CONSUMERS

| | | Merchandising Policy of those Companies which Merchandise Only | | | | | | Merchandising Policy of those Companies which Merchandise and Give Free Renewals | | | | | | Free Renewal Policy of those Companies which Merchandise and Give Free Renewals | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | See foot-note (a) | A | B | C | D | E | Total | A | B | C | D | E | Total | A | B | C | D | E | Tota |
| Conditions controlling free renewals | Minimum wattage of lamps supplied on free renewals: | | | | | | | | | | | | | | | | | | |
| | Mazda | Not applicable | | | | | | Not applicable | | | | | | ϕ | ϕ | 40 | 250 | 50 | 40 |
| | Gem | Not applicable | | | | | | Not applicable | | | | | | 30 | 30 | 20 | 30 | 30 | 30 |
| | Carbon | Not applicable | | | | | | Not applicable | | | | | | 60 | 10 | 10 | 10 | 10 | 10 |
| | Maximum wattage of lamps supplied on free renewals: | | | | | | | | | | | | | | | | | | |
| | Mazda | Not applicable | | | | | | Not applicable | | | | | | ϕ | 500 | 500 | 500 | 1000 | 500 |
| | Gem | Not applicable | | | | | | Not applicable | | | | | | 100 | 100 | 100 | 100 | 100 | 100 |
| | Carbon | Not applicable | | | | | | Not applicable | | | | | | 60 | 120 | ϕ | 120 | 50 | 120 |
| | Number of renewals supplied at one time or during a given period | Not applicable | | | | | | Not applicable | | | | | | Unlimited | | | | | |
| | Percentage of lamps required to fill a consumer's sockets which is supplied as an emergency on the first installation | Not applicable | | | | | | Not applicable | | | | | | ϕ | None | None | None | ϕ | None |
| | Return of old lamps or stubs to get free renewals | Not applicable | | | | | | Not applicable | | | | | | Necessary | | | | | |
| | Identification of old lamps or stubs to get free renewals | Not applicable | | | | | | Not applicable | | | | | | Not necessary | Not necessary | Necessary | Necessary | Necessary | Necessary |
| | Means of identification of old lamps | Not applicable | | | | | | Not applicable | | | | | | Not identified | Not identified | (b) | Etching | Etching | Etching |
| | Identification of customer | Not applicable | | | | | | Not applicable | | | | | | Not required | Required | Required | Required | Required | Required |
| | Special requests for the delivery of lamps | Not applicable | | | | | | Not applicable | | | | | | Complied with | | | | | |
| Delivery of lamps | Means of delivery | Over counter | Over counter | Over counter | Delivery wagon and over counter | ϕ | Over counter | Over counter | (c) | Delivery wagon and over counter | Delivery wagon and over counter | Delivery wagon messenger and over counter | Delivery wagon and over counter | Over counter | Delivery wagon and over counter | Over counter | Delivery wagon and over counter | Delivery wagon, messenger and over counter | (b) |
| | Least number of lamps delivered at one time for first installation or free renewals | Not applicable | | | | | | Not applicable | | | | | | One | | | | | |
| | Kind of delivery wagon | Gas | Gas | Gas | Gas | (e) | Gas | Gas | Gas | Gas | (d) | Gas | Gas | Gas | Gas | Gas | Electric | Electric and horse | Gas |
| | Means of identification of delivery men | Not identified | Not identified | (f) | Not identified | Not identified | Not identified | Not identified | Badges | Badges | Badges | Badges | Badges | Not identified | Badges | Badges | Badges | (i) | Badges |
| | Lamps are installed by | Delivery men if requested | (g) | Customer | Customer | Customer | Customer | Delivery men if requested | Customer | Delivery men | Customer | Customer | Customer | Delivery men | Delivery men | Delivery men | Delivery men | Customer | Delivery men |
| | Delivery wagons transport | Lamps and other articles | | | | | | Lamps and other articles | Lamps and other articles | Lamps and other articles | Lamps and other articles | Lamps only | Lamps and other articles | Lamps and other articles | Lamps and other articles | Lamps and other articles | Lamps and other articles | Lamps only | Lamps and other articles |
| | Tests of lamps are made | In consumer's presence | | | | | | In consumer's presence | | | | | | Question not asked | | | | | |

evenly divided between "Electric" and "Horse." (f) Indeterminate:—Replies evenly divided between "Badges" and "Not identified." (g) Indeterminate:—Replies evenly divided between "Customer" and "Delivery men." (h) Indeterminate:—Replies evenly divided between "Over counter" and "Delivery wagon and over counter." (i) Indeterminate:—Replies evenly divided between "Badges" and "Uniforms, badges and caps."

# ADVANCE IN TECHNICAL THEORY AND PRACTICE

*Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World*

## AN EASILY ADJUSTABLE ELECTROSTATIC VOLTMETER

### Portable Instrument for Measuring Very High Voltages Such as Are Used in Electrostatic Fume and Dust Precipitation

BY E. R. WOLCOTT

Western Precipitation Company, Los Angeles, Cal.

IN THE electrical precipitation of dust and fume it is often desirable to measure high voltages with apparatus which is easily adjusted and readily transported. To meet these requirements a modified form of the Kelvin guard-ring voltmeter described in the ELECTRICAL WORLD of May 13, 1916, has been developed.

As shown in Fig. 1, the lower part of the instrument contains the attracted disk *D*, which forms one pan of a balance beam. The insulating support for the upper plate is removable at the base, and the whole packs readily in a flat box and is easily put together for use or packed for transport.

In order to operate the screw *S* is adjusted so that the upper surface of the disk *D* is flush with the upper surface of the guard ring *G*—that is, so that the pointer of the balance registers zero while a 500-milligram weight rests at *W*. This weight is then removed, whereupon the disk *D* falls slightly—that is, until the beam makes contact at *T*. The plate P is then connected to the high-voltage line, while it is some distance from the guard ring *G*; it is then lowered by means of the knurled head and ratchet, which unwinds a silk string until the disk *D* is attracted so as to again be just flush with the guard ring *G*—that is, so that the pointer on the beam indicates zero. The distance between the plates is then read from the scale by the indicator *I*. This, however, is usually marked to read volts directly.

Since the electrostatic attraction is measured by comparison with the attraction of gravity, if the mass of the weight at *W* and the area of the disk *D* are known, the relation between the voltage *e* and the distance *d* between the plate *P* and guard ring *G* can be expressed as follows:

$$e = 300\, d \sqrt{\frac{8\pi\, m\, g}{\pi\, r^2}}, \text{ where}$$

$e$ = volts in electromagnetic units;
$d$ = the distance between the plate $P$ and guard ring $G$ in cm.;
$m$ = the mass of weight added at $W$ in grams;
$g$ = the acceleration of gravity = 980.6;
$r$ = the radius of the disk $D$ in cm.;
300 = the constant of transformation from electrostatic to electromagnetic units.

If $m$ = 500 milligrams, and $r$ = 1.5 in. = 3.8 cm., then when $d$ = 1 cm.,

$$e = 300 \sqrt{\frac{8 \times 0.5 \times 980.6}{14.5}} = 4935 \text{ volts per cm.}$$

The diameter of the plate *P* and the guard ring *G* should be larger than the maximum distance to which they are separated. In the instrument shown in the illustration, the diameter of the plate *P* was 10 in. and it

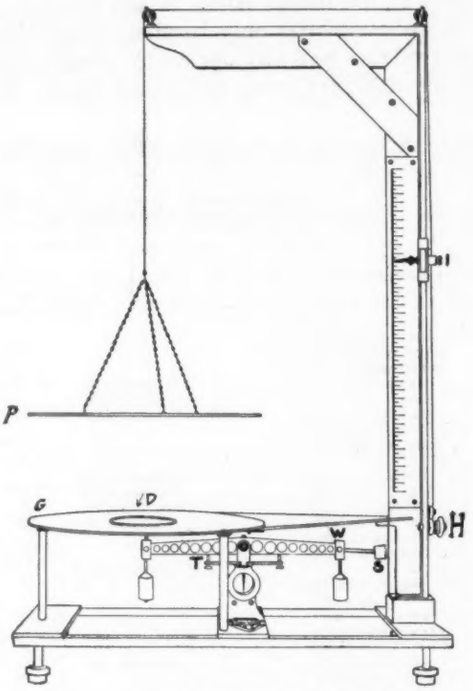


FIG. 1—PORTABLE ELECTROSTATIC VOLTMETER
*W*—weight. *S*—screw. *D*—disk. *G*—ring. *T*—stop. *P*—plate. *H*—knurled head. *I*—indicator.

was used to measure 100,000 volts—that is, about 20 cm. distance between the plate *P* and guard ring *C*.

The accuracy of the instrument depends upon that of the beam, which is readily constructed as to permit of readings within 1 per cent.

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### Generators, Motors and Transformers

*Contact Resistance of Carbon Brushes.*—R. CZEPEK.—An account of tests made with the object of elucidating the character of the processes taking place at the contact between brush and commutator. Two brushes were placed on the commutator of a rotary converter, the commutator being short-circuited by winding copper binding wire around it. The voltage was measured between the slip rings of the rotary converter and either brush, the currents and voltages being recorded by an oscillograph and measured by meters and voltmeters. The supply was direct current or alternating current or slowly fluctating direct current. The tests were made at constant brush pressure, constant current density and constant commutator speed. The resistance at the contact may be regarded as a combination of the resistance of a solid conductor and of an arc. On this

account the voltage-current characteristic rises quickly at low currents and then at a slower and slower rate as the current is increased. When fed with alternating current the contact resistance exhibits a hysteresis effect on account of the great sensitiveness of the contact to temperature changes. This is revealed in a number of dynamic characteristics showing the variation of the voltage across the contact, and of the contact resistance, over complete cycles of currents. As the electrodes have very different heat conductivities the hysteresis loops generally change their direction of rotation with a change of the cathode. Also the voltage in the direction from commutator to brush is generally greater than in the reverse direction. Thermo-electric effects are also noticeable, arising from unequal warming of the electrodes. The direction of the thermo-electric voltage depends on the material of which the brush is composed.—From *Archiv f. Elektrot.*, abstracted in *Science Abstracts*, Section B, March 31, 1917.

## Lamps and Lighting

*High-Vacuum Mercury-Vapor Pump.*—CHARLES T. KNIPP.—The diffusion pump of Gaede has stimulated a number of new designs of high-vacuum pumps. The author describes a design made wholly of glass as an improved high-vacuum high-speed mercury-vapor pump (Fig. 2). The bulb to be exhausted and trap are fused to *B*, while the tube *E* is attached to the supporting or rough pump. The mercury vapor rising from the lower bulb, which is heated in a sand or heavy oil bath, streams up through the short tubes *P* and *O* and is deflected downward through an annular throat by an umbrella *N*. The issuing mercury vapor at once condenses on the water-cooled surface of the enveloping tube, and the gas that comes from *B* is forced mechanically downward from the lower edge of *N* along the cooled surface of the condensing chamber. This accumulated gas is removed through the lateral tubes *bb*, which unite at the top and form the exhaust tube *E*, all being enveloped by the water jacket *XY*, as shown in the figure. This construction keeps the mercury, which collects at the ring-seal 3, cool, and thus removes the objection that mercury vapor having an upward velocity would enter the annular condensing chamber. A small opening shown at 3 serves as a valve which allows the accumulated mercury to pass, yet owing to surface tension maintains a perfect seal. The short tube *P* is inserted to shield the hot mercury vapor streaming up from the boiler from condensing on the surfaces at 3. The upper end of *P* telescopes loosely into the lower end of *O*, while the lower end is secured by the ring-seal 1, having also a small valve opening in it through which the mercury passes back into the boiler. By making the upper end of *P* conical, condensed mercury vapor is caught in the annular space formed and automatically seals the space *PO* from the cavity just outside of *P*. The cold mercury collected at the ring-seal 3, and the adjacent water-jacket, thus have but little opportunity of cooling the hot stream of mercury vapor passing up through *PO*, and furthermore, the temperature gradients between the ring seals 1 and 2, and 3, and *bb* are not abrupt; hence there is no danger of the glass cracking. This construction very much simplifies the glass-blowing, since the tube throughout the process is kept perfectly symmetrical.—*Phys. Review*, April, 1917.

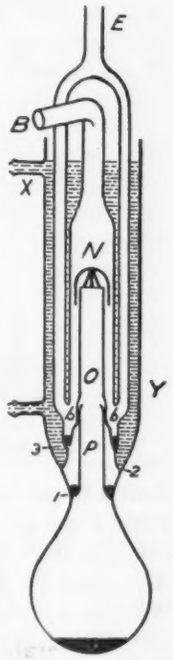

FIG. 2—HIGH-VACUUM PUMP

## Generation, Transmission and Distribution

*Calculation of Transmission Lines.*—B. GUERSCHINOVITCH.—In the predetermination of a transmission line not only the present conditions but probable future extensions have to be taken into consideration. The author describes a method of calculating a transmission line for a three-phase system. He first determines the minimum cross-section $s$ of a conductor which permits the transmission of a given power at a certain voltage (the transmission loss in this case just equaling the power). He then considers a large section $S = n\,s$ and determining $n$ in such a way that the power loss in transmission is a given percentage $a$ of the transmitted power. The relation between $n$ and $a$ is determined and given in a diagram. He then discusses the determination of a cross section $S = n\,s$, for which the value of $n$ is such that the sum of the power loss in the transmission line and the amortization of the copper becomes a minimum. The results of the calculations are given in algebraic form and in a series of diagrams. The same method can be applied for single-phase transmission and direct-current transmission and the diagrams given in the article can be used for such purpose.—*Revue Gen. de l'Elec.*, April 7, 1917.

## Installations, Systems and Appliances

*Limitation of Short-Circuit Currents.*—G. KLINGENBERG.—It has been shown by Binder and Biermanns that the very large currents due to short circuits give rise to great mechanical strains that are produced so quickly that the most rapid-acting circuit breakers afford insufficient protection. The short-circuit currents in "the greatest steam-driven generating station of the world, at Golpa," have been limited in magnitude as follows: The station transmits 60,000 kw. over a distance of 25 km. (15 miles) at 80,000 volts besides supplying 30,000 kw. at 6000 volts in the more immediate neighborhood. Eight turbo-generators of 22,500 kva. each at 6000 volts are installed. The first portion of the supply is furnished by four generators over two lines of masts with two circuits each (in all $2 \times 2 \times 3$ conductors). The conductors on each line of masts can carry the total load with increased losses in case of emergency. The maximum short-circuit current of the alternators is fifteen times the normal current. If the four alternators were paralleled in the usual way, a maximum short-circuit current of 135,000 amp. would have been possible. On this account their direct connection in parallel has been completely avoided and the paralleling has been arranged for behind the 80,000-volt transformers, the reactance of which limits the short-circuit currents that can flow. The number of transmission circuits was chosen equal to that of the generators and their transformers so that the circuits might not have to be connected in parallel at the generating station, and provision is made for the possibility of subdividing the 80,000-volt busbars so that each generator may feed

one of the four transmission circuits, which may be connected in parallel at their loaded ends, thus adding the line reactance to the path of a short circuit taking place on the consumers' installation. In a diagram of connections the four generators are shown each supplying a step-up transformer through a current-limiting reactance; each transformer can supply either or both of a pair of 80,000-volt busbars, and each line can be connected to either or both of these busbars. Each pair of busbars is subdivided by a link with switches at either end into two portions, each of which is associated with two of the four transmission lines and two of the alternators. The links may be connected together by coupling switches. A local supply of power at 6000 volts can be given by the same generators through a second set of current-limiting reactive coils of such a magnitude that there is no danger in connecting the generators in parallel through them at a system of duplicate busbars. By the above arrangements and by exercising great care in the insulation of the machines it has been possible to carry out the installation without any over-voltage protective devices, and no disturbances from over-voltage have been experienced even in heavy thunderstorms.—From *Elek. Zeit.*, Dec. 14, 1916; abstracted in *Science Abstracts*, Section B, March 31, 1917.

## Electrophysics and Magnetism

*Change of Resistance in Light.*—T. W. Case.—The author has made a systematic search for substances which show a change of resistance when exposed to light. The apparatus used consists essentially of an arc lamp and a variable-speed water motor mounted upon a concrete base. The water motor drives a disk which has fifteen sectoral openings, and so serves rapidly to interrupt the beam of light produced by the arc and brought to focus upon the substance under observation. Lead wires run from this substance to an Ayrton shunt, connected to a three-step audion amplifier. High-resistance receivers can be inserted in any one of these steps, and if any photoelectric action is produced by the interrupted beam of light, a distinct note is heard in the receivers. The results of the author's research are given in a long table. Two specimens which show remarkable action are acicular crystals of bismuth sulphide (bismuthinite) and a granular lead antimony sulphide. The resistance of a piece of the latter 1 mm. by 10 mm. reduces about 5000 per cent from the value in the dark in dull sunlight at an applied potential of 110 volts. If the substance be actually heated up, either by exposure to heat or passing a current which slowly heats the substance, then the resistance is gradually lowered, but this is a slow process. All of the photo-active sulphides show the quick light reaction in the red part of the spectrum. Both the bismuthinite and the lead antimony sulphide give fine results when used as a transmitter in a photophone system, using a manometric flame for transforming the voice variations into light variations. The voice reproduction is very clear and loud.—*Phys. Review*, April, 1917.

## Electrochemistry and Batteries

*Aluminum.*—A review of the international aluminum industry. The demand for aluminum has increased greatly during the last few years. While the German, Swiss, French and British works have had difficulty in extending greatly under war conditions, the aluminum industry in the United States has made enormous progress. It is estimated that the present capacity of the aluminum production throughout the world is 100,000 tons per year, and if the schemes in process of execution are taken into consideration the capacity will rise to 150,000 tons in the near future, of which the United States and Canada will produce 75,000 tons, France 20,000 tons, Switzerland and Germany 20,000 tons, Great Britain 12,000 tons, Norway 16,000 tons, and Italy 7000 tons. Such a large production would prevent excessive prices of aluminum, but it is questioned whether sufficient supply of alumina, bauxite, cryolite, etc., will be on hand in time to produce such an output.—London *Elec. Review*, March 30, 1917.

## Units, Measurements and Instruments

*Automatic Device for Charging Electroscope.*—L. Kolowrat.—An illustrated description of a convenient automatic device for charging a sensitive aluminum-leaf electroscope for laboratory and field work with radioactive minerals. As shown in Fig. 3, it consists

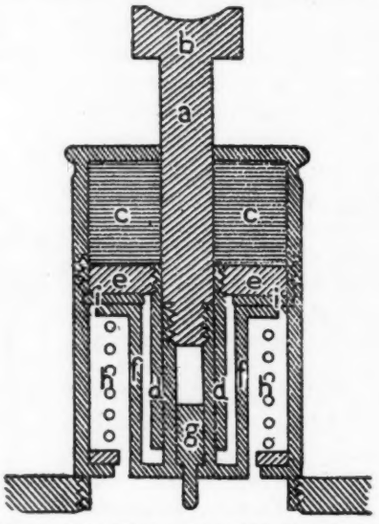


FIG. 3—AUTOMATIC DEVICE FOR CHARGING AN ALUMINUM-LEAF ELECTROSCOPE

essentially of an ebonite rod *a* which, while being pushed down by means of the button *b*, is rubbed against cloth placed at *c*—*e.g.*, in form of a pile of perforated disks. During the subsequent motion the charge thus produced is collected on the fixed brass tube *d*, insulated by the ebonite collar *e*. This tube remains, on the other hand, in permanent connection with the piece *ff*, consisting of two coaxial cylinders and moved together with *a*. When the rod is at the end of its path a small finger *g* lightly touches the support of the leaf to be charged. By releasing the pressure on *b* the spring *h* brings the rod to its original position, simultaneously connecting *f* with the brass disk *i*, and consequently with the electroscope case. The dimensions being chosen consistent with the capacity of the leaf support, things are easily adjusted so as to produce a convenient deflection of the lead with a single push of the button. A good plan is to overcharge the leaf a little and to keep the button down until the system has discharged itself to the desired point, which is readily attained owing to the leak through the ebonite parts of the charging device.—*Philos. Mag.*, April, 1917.

# *Scientific and Industrial Research*

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Facilities Available, and Suggestions for Co-operative Work.

*Conducted by* PROF. VLADIMAR KARAPETOFF
Cornell University

## RUPTURING CAPACITY OF LARGE OIL SWITCHES

### Apparent Lack of Information on This Subject Is Due to the Lack of Systematization of Data That Has Prevailed

BY M. S. DIAMANT

Rice Institute, Houston, Tex.

Referring to the remarks of P. H. Chase, Public Service Electric Company, New Jersey, in the April issue of the Research Section in regard to the lack of data on rupturing capacity of oil switches and the factors that determine the rating, it seems to the writer that the trouble is not so much with lack of data as with lack of systematization of data. Only very large manufacturing concerns and some operating companies are able to conduct tests on oil switches, since the kva. capacity required for such investigations is enormous. Considerable sporadic work has been done along this line, but theory and scientific study still seem to be in the development stage, and will continue to be so long as there is lack of information regarding transient phenomena and other factors which vitally affect the operation of all switches. Until more is learned about the theory of this kind of apparatus, no approximate predeterminations of performance can be made without recourse to long and expensive tests. The results of actual tests cannot always be generalized, and hold only for the cases considered.

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## Reducing Hazards from the Use of Household Electrical Appliances

The wide and rapidly extending use of electrical appliances for industrial and domestic purposes has brought the attention of the Underwriters' Laboratories to the necessity of requiring the manufacturers of portable apparatus, like electric pressing irons, small motors, cooking and heating appliances, to construct or equip them so that fire hazards from the careless use of such appliances will be minimized. Devices of this nature are often installed without instructions or supervision from inspection authorities and are almost invariably used by inexperienced persons.

Dana Pierce of the Underwriters' Laboratories has recently made the point that it should be possible to embody in the construction of these appliances features which would minimize the liability of misuse or remove the fire hazards. Such inventions and applications would fill a great need and would undoubtedly be welcomed by manufacturing interests, insurance and inspection authorities of states and municipalities, and by the general public.

## Summary of Investigations, Available Apparatus and Research Suggestions

### SUBJECTS BEING INVESTIGATED (RESEARCH WORK REPORTED SINCE APRIL 21)

ALTERNATOR.
Armature reaction studied by means of oscillographic records.—*Carnegie Institute of Technology, Alex. Jay Wurts.*

COAL.
Lignite, utility of grades available in Manitoba for the manufacturer producing gas for power and domestic purposes.—*Public Utilities Commission (Manitoba), George L. Guy and Mr. McNair.*

CONTROL.
Arrangements for controlling electrical power at any frequency.—*University of Southern California, August Hund.*

ELECTROMAGNETIC WAVES.
Absorption of.—*Carnegie Institute of Technology, Alex. Jay Wurts.*

GENERATORS.
Induction type, operation and efficiency of small units.—*Throop College of Technology, Pasadena, Cal., R. W. Sorensen and C. E. Baker.*

HEAT CONDUCTIVITY.
Insulating paint.—*University of Missouri, A. C. Lanier and M. P. Weinbach.*

INSULATORS.
(1) Depreciation on transmission lines. (2) Development of a portable outfit for testing insulators after removing from transmission lines.—*Throop College of Technology, Pasadena, Cal., R. W. Sorensen.*

MEASUREMENTS.
High voltage.—*Carnegie Institute of Technology, Alex. Jay Wurts.*
Magnetic flux density, permeability and copper and iron losses up to any desired frequency.—*University of Southern California, August Hund.*
Efficiency of arc oscillations of the first, second and third type, with the view to increasing the output of oscillations of the first type.—*University of Southern California, August Hund.*
Rating of coils with special reference to those used in high-potential high-power transformers.—*University of Southern California, August Hund.*

PHASE TRANSFORMATION.
Vector relations in the Taylor system.—*Carnegie Institute of Technology, Alex. Jay Wurts.*

TRANSFORMERS.
Theoretical design.—*Carnegie Institute of Technology, Alex. Jay Wurts.*

TRANSFORMER OIL.
The megger as a means of determining the condition of transformer oil.—*Throop College of Technology, Pasadena, Cal., R. W. Sorensen.*

TRANSMISSION.
Iron wire, mechanical and electrical tests, including inductive effect of power current in iron wires adjacent to telephone wires.—*University of Oklahoma, L. W. W. Morrow.*

### APPARATUS AVAILABLE FOR RESEARCH PURPOSES

CARNEGIE INSTITUTE OF TECHNOLOGY.
(1) 200,000-volt, 60-cycle, 100-kva. transformer; (2) 10-kw., 500-cycle radio station with 700-ft. aerial and equipped with vacuum-valve receiving sets for both spark sets and sustained-wave reception; (3) three-element oscillograph with complete photographic attachment; (4) railway motor flywheel set with hand and electro-pneumatic control; (5) variable-frequency generators ranging from 25 to 600 cycles; (6) large-current testing transformers with regulator control.—*Alex. Jay Wurts.*

UNIVERSITY OF WASHINGTON.
(1) An artificial transmission line with adjustable constants (see A. I. E. E. *Proceedings*, August, 1916); (2) Drysdale-Tinsley alternating-current potentiometers; (3) 200,000-volt, 20-kw. transformers.—*Prof. C. E. Magnusson.*

### SUGGESTIONS FOR RESEARCH

CHARACTERISTICS OF SHORT-CIRCUITED ALTERNATOR.
Referring to Prof. A. H. Forman's work on the armature reaction of an alternator, mentioned in the April issue of the Research Section, I should like to make the following suggestions: (1) By means of two full-pitch exploring coils placed on the field system, with the coil sides coinciding with the axes of the pole and the geometrical interpolar axis respectively, investigate the flux pulsations under load and under sustained short circuit and compare the results with the pulsations obtained under no load. From investigations made by the writer it appears that with no load the space oscillations and pulsations in intensity of the air-gap flux wave are larger than when the machine is run idly as a synchronous motor. (2) By means of full-pitch exploring coils placed at the top and bottom of the armature slots, determine whether the emfs. induced in the upper coils are smaller than those induced in the lower ones. (3) The extent to which concentrated-turn exploring coils or single conductors will give a reliable indication of the actual flux distribution. This last-mentioned investigation is advisable since the time rate of change of the B-curve would only be proportional to the emf. measured, provided it is entirely motional. Variational emf. is bound to occur, owing to oscillations and pulsations of flux. In connection with Professor Forman's work it would also be interesting to know the extent to which the armature current under two-phase and single-phase sustained short circuit approaches the ideal sine wave.—*M. S. Diamant, the Rice Institute.*

RADIO DETECTORS.
The writer is impressed with the necessity of developing some suitable detector for radio work which will be better than the apparatus available at present for the purpose. The audion is a very remarkable device but is erratic in perform-

ance. Further study of the audion to increase its sensitiveness and stability would also be of great practical value. Another line of research which should prove of considerable value would be the study of electric arcs under pressure such as exist in oil switches.—*Ernst J. Berg, Union College.*

MISCELLANEOUS.

(1) investigation of noise in rotating machines, analysis of causes and means of prevention; (2) study of commutation under rapidly varying peak-load service, particularly where reversal with dynamic braking or plugging is required; (3) heat flow and dissipation of heat with special reference to direct ventilation in rotating machines; (4) leakage of high-reactance transformers employing magnetic shunts; (5) heat flow through conducting and insulating materials, includ ng varnishes, paints, and built-up materials.—*A. C. Lanier, University of Missouri.*

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# DEVELOPING NATURAL RESOURCES

## Plans Outlined by Scientific and Industrial Research Committee of the A. S. C. E., Manitoba Branch

BY GEORGE L. GUY

Public Utilities Commission, Manitoba

As a result of the present war conditions the Manitoba branch of the American Society of Civil Engineers has organized a scientific and industrial research committee to organize and develop the natural resources in industry and science. At present this committee is listing all available research laboratories in its jurisdiction, also all men engaged in scientific and engineering pursuits and the qualifications of each man in his particular line of research or engineering. After organization is completed a study will be made of the requirements of the Province of Manitoba as regards manufactured articles, and more especially imports, with a view to supply all local demand for such material and, if possible, to provide for export, if it can be economically accomplished.

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## Purdue Trustees Approve Organization of Engineering Experiment Station

According to C. F. Harding of Purdue University, the faculty has been very much encouraged to enter research work by the recent action of the board of trustees of this institution in approving the organization of an engineering experiment station. This station will be employed for the supervision of engineering research. Arrangements have also been made by the board of trustees for the extension and equipment of a high-voltage laboratory, in which pressures as high as 500 kv. can be obtained.

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## Necessity of Shop and Laboratory Facilities

Many engineers who wish to do private research work find it difficult to secure suitable shop facilities for constructing models and apparatus. For this reason the writer is inclined to believe that a few suitably conducted shops, possibly with private laboratory facilities, would not only be highly appreciated by many engineers but could be made profitable.—*Jay Grant De Remer, New York.*

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H. W. Buck, president of the American Institute of Electrical Engineers, in a letter to the ELECTRICAL WORLD, says: "I do not know of any matter of more importance to the future of electrical engineering than the research work which seems to be in the spirit of the times."

# FEATURES OF THREE CONGRESSIONAL BILLS ON SCIENTIFIC AND INDUSTRIAL RESEARCH

GRONNA BILL. (Senate 7037—Dec. 5, 1916)

Object:
Promotion of engineering and industrial research.

Where or how:
Through national, state and territorial research boards, utilizing laboratories, equipment and individuals of any institution of learning or research within the state or territory.

Purpose:
To aid in the promotion of engineering research, industrial progress and scientific investigations, and the distribution among the people of the resulting useful and practical information, and to aid in developing the natural resources of the United States as a measure of industrial and military preparedness.

Scope of work:
Engineering, chemical, physical and economic problems connected with water supply, sewerage, disposal of wastes, flood protection, drainage and irrigation of lands, transportation, lighting and heating, development of power, manufacture of materials, marine architecture, etc.

Bulletins to be published:
At least one every year.

Annual appropriation:
$15,000 for each state and territory and $15,000 for the expenses of the National Board.

General supervision rests with:
Secretary of Commerce and a national board of engineering and industrial research.

Local supervision and administration of the moneys rests with:
The state or territorial research board, to consist of five engineers or scientists engaged in the development of engineering and industrial science and appointed by the national board. First consideration to be given nominations by the presidents or chancellors of the several institutions of higher learning in the state or territory concerned receiving public aid, the presidents of at least two other institutions of higher learning maintaining technical departments, the governing board or committee of at least one technical society or association of state-wide or territorial character, and the governing boards or committees of not less than four engineering societies or associations of national character.

Authorization and co-ordination of research:
The executive committee of the national board to pass on each subject for research submitted by state boards.

Annual report:
State and territorial boards to report to the Secretary of Commerce; copy to be sent to each of the other boards, to Secretary of Commerce, to each member of the national board, and to the Secretary of the Treasury of the United States.

NEWLANDS BILL. (Senate 4874—March 9, 1916)

Object:
To establish experiment stations in engineering and in other branches of mechanic arts.

Where or how:
In connection with the land-grant college in each State or territory.

Purpose:
To aid in acquiring and diffusing among the people useful and practical information on engineering and to promote the scientific investigation and experiments respecting the principles and applications of the mechanic arts.

Scope of work:
To conduct original researches, to verify experiments and to compile data; also to conduct researches, investigations and experiments in connection with materials of engineering, water supplies, sewage purification, disposal of wastes, flood protection architecture, road building, transportation, manufacturing, public utilities, etc.

Bulletins to be published:
At least once in six months.

Annual appropriation:
$15,000 to each state and territory.

General supervision rests with:
Secretary of the Interior.

Local supervision and administration of the moneys rests with:
The land-grant college itself.

Authorization and co-ordination of research:
General supervision by the Secretary of the Interior.

Annual report:
Each station to report to the Governor of the state or territory in which it is situated. Copy to be sent to each of the other stations, to the Secretary of the Interior and to the Secretary of the Treasury of the United States.

SMITH-HOWARD BILL. (Smith Bill, Senate 933—April 6, 1917; Howard Bill, H. R. 2611—April 10, 1917)

Object:
To establish engineering experiment stations for the promotion of engineering and industrial research.

Where or how:
In connection with some state-supported engineering school or university having a department of engineering.

Purpose:
To aid in the promotion of engineering and industrial research and distribution among the people of the resulting useful and practical information; to aid in developing the natural resources of the United States as a measure of industrial and military preparedness.

Scope of work:
Same as Newlands bill and, in addition, to make tests and investigations in any or all branches of engineering, manufacturing and the industries; aeronautics; and those bearing on the public welfare of the people.

Bulletins to be published:
At least once in twelve months.

Annual appropriation:
$15,000 to each state, territory and the District of Columbia and, in addition, $25,000 to the Bureau of Standards for Supervision and co-operation.

General supervision rests with:
Secretary of Commerce through the Bureau of Standards.

Local supervision and administration of the moneys rests with:
The station itself.

Authorization and co-ordination of research:
Supervision by and co-operation with and through the Bureau of Standards.

Annual report:
Each station to report to the Governor of the state or territory in which it is situated Copy to be sent to each of the other stations, to the Secretary of Commerce and to the Secretary of the Treasury of the United States.

# NEWS OF THE INDUSTRY

*Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields*

## ASSOCIATED MANUFACTURERS ACT ON WAR REVENUE TAX

### Will Accept Without Demur the Decision Ultimately Reached, but Recommend English Plan—H. B. Crouse Elected President

At the meeting of the board of governors of the Associated Manufacturers of Electrical Supplies held in New York on May 16 the following telegram was sent to the finance committee of the United States Senate and the United States Chamber of Commerce:

"The board of governors of the Associated Manufacturers of Electrical Supplies, representing substantially this entire industry, at its regular meeting to-day in New York unanimously passed the following resolution and directed that a copy be sent to the finance committee of the United States Senate and to the Chamber of Commerce of the United States:

"Resolved, that without departing in any way from its attitude of co-operation with the government in its effort to cope with the present situation and while accepting without demur the decision ultimately reached, the opinion of this board is that the principle upon which the English government bases the assessment of so-called excess profit taxes is superior to that embodied in present United States legislation from the viewpoint of equity, simplicity and continuing business activity.

"H. B. CROUSE, president."

Mr. Crouse was elected president at the meeting. He succeeds Robert K. Sheppard, the first president, whose desire was that the organization be kept representative and democratic by rotation in the chief executive office. Mr. Crouse is president of the Crouse-Hinds Company, Syracuse, N. Y.

A. W. Berresford, Cutler-Hammer Manufacturing Company, Milwaukee, Wis., was elected vice-president. J. W. Perry, H. W. Johns-Manville Company, was re-elected treasurer. Charles K. Dustin, the general secretary, was re-elected.

## CLOSE OF CAMPAIGN FOR 1917 "WIRE-YOUR-HOME TIME"

### Preliminary Reports to Society for Electrical Development Indicate Success of Movement, Notwithstanding Adverse Conditions

Tuesday, May 15, marked the close of the "wire-your-home time" campaign held during the last six weeks throughout the country.

Preliminary reports received by the Society for Electrical Development indicate that in spite of adverse conditions, such as increased labor and material costs and correspondingly increased wiring prices, as well as scarcity of equipment, the event was a marked success. Several cities have already stated that they obtained even more business than the record during last year's "wire-your-home month." The society's committee, of which G. M. Sanborn of Indianapolis is chairman, will announce the winners in the prize contest on or about June 15.

## TURBINE ORDER PLACED AGGREGATING 200,000 KW.

### Brady Interests, to Meet Power Requirements, Allot Contracts to General Electric Company

The Brady interests have placed within the last few days an order for turbines totaling 200,000 kw. rating. The order was placed with the General Electric Company. This is stated to be the largest single order for turbines ever placed.

## SUCCESSFUL STOCK SALE BY UNION COMPANY OF ST. LOUIS

### Customers Buy $500,000 of a New Issue of 7 Per Cent Preferred Shares in One Week

In one week the Union Electric Light & Power Company of St. Louis sold to its consumers $500,000 of a new issue of 7 per cent preferred stock. This result


**A Safe 7% Stock for Our Customers Only**

We want a large number of our customers to become our active partners.

**We therefore offer, TO OUR CUSTOMERS ONLY, 5,000 $100 shares of Union Electric 7% preferred stock—at par for cash; at 102 on time payments.**

Union Electric has authorized an issue of $2,000,000 of 7% preferred stock to provide funds for future extensions of the business. Of this amount $1,000,000 has been issued with the approval of the Public Service Commission of Missouri. The remainder will be issued from time to time, the Commission approving, as extension funds are required. The $500,000 here offered is one-half of the above $1,000,000 issue.

Terms of sale:

(a), for cash at the Company's sales offices at $100 a share, to earn 7%.

(b), on a 10-payment installment plan at $102 a share, to earn 6.86%.

Installments to be paid monthly—$10.20 on each share—with Electric Service bills.

The Company to pay buyers of stock 5% interest, credited quarterly on the first day of January, April, July and October, on installment payments.

Buyers to have the option to withdraw all installments paid, with interest credited, on 10 days notice, any time before full amount has been paid.

Stock certificate to be issued to buyer when final payment is made.

OFFER LIMITED TO OUR CUSTOMERS ONLY.

Not more than 20 shares to be sold to any customer.

This stock has the same voting power as the Company's common stock. It is preferred as to dividends and distribution of assets. It is redeemable by the Company at 105. Preference as to dividends is not cumulative.

The physical value of the Company's property far exceeds the outstanding bonds and preferred stock.

The Company's net earnings, each year since 1907, after paying bond interest, have been seven to twelve times as large as the sum needed to pay 7% on its outstanding preferred stock.

Owing to its progressive and liberal policy, the Company's business is rapidly and healthfully growing.

THE COMPANY'S SECURITIES ARE NOT "WATERED," AND UNDER STATE REGULATION NEVER CAN BE.

This 7% preferred has therefore virtually the security of a good bond, with the higher earning power of a good stock.

This offer seems certain to be taken up quickly. The rule is: First come, first served. If you are a customer, and want a part of the lot, up to 20 shares, better get in line early.

**The Electric Company**

UNION ELECTRIC: Main Office—12th and Locust
Branches: 4912 Delmar; 3628 N. Grand; 3012 S. Grand
SIX OFFICES IN THE COUNTY


was achieved without solicitation on the part of the company and solely by newspaper advertisement. Four successive advertisements were in the series.

# WAR REVENUE TAX ON ELECTRIC ENERGY FOR DOMESTIC USES

## Discussion Before Senate Finance Committee by Representatives of Public Service Corporation and Southern Utilities Company

The United States Senate finance committee is conducting hearings on the war revenue tax bill, which is designed to produce $1,800,000,000. The hearings are being divided into groups and, for the most part, are as brief in their details as the bill itself, which, consisting of only fifty-four pages, is the greatest tax measure ever introduced into any legislative body in the world.

When the hearing on "public utilities," as a group, was called, Edmund W. Wakeley, Public Service Corporation of New Jersey, and Z. V. Taylor, representing the Southern Utilities Company, appeared. They discussed different phases of the bill, as reported to the House by the House ways and means committee.

It is the general understanding in Washington, especially in administration circles, that the war tax bill will be framed in the Senate finance committee very nearly in the form in which it will become a law, irrespective of what the House ways and means committee reported in the bill. It is also the general understanding in Washington that there will be weeks of debate in committee and possibly in the Senate on some of the proposals contained in the bill, although there is also a general belief that the statesmanship and patriotic purpose of the industries of the country in responding to tax requirements which are hitting all industries, under the bill, will certainly not be less than can be found in Congress.

President Wilson began on Tuesday night at the White House a series of conferences designed to straighten out opposing interests on all war legislation, and the war revenue tax bill, it is understood, will engage much of his attention for some time, as it is certain there are many inequalities in it. For one thing, there has been a disposition to criticize the bill on the part of each special interest. It is not doubted in administration circles in Washington that each special interest desires to shoulder its share of the coming burden, however; but in some cases there is a belief that some interests have not adequately presented their views to the Senate finance committee. This, it is stated, can still be done in letters to Senators and Representatives who have charge of framing the bill.

The examination of Mr. Wakeley and Mr. Taylor at the hearing before the Senate finance committee proceeded upon the following lines, as stenographically reported:

### STATEMENT OF EDMUND W. WAKELEY

Mr. WAKELEY. Mr. Chairman, I did not hear the chairman call the electric light and power companies.

The CHAIRMAN. We have just been discussing those.

Mr. WAKELEY. Not Section e. I only want thirty seconds, just to ask a question.

The CHAIRMAN. What is it you want to take up?

Mr. WAKELEY. Electric light and power. I did not hear any announcement of that section, which you will find at the bottom of page 20:

"e. A tax equivalent to five per centum of the amount paid for electric power for domestic uses."

I simply want to ask the committee to clear up what they mean by that word "domestic." We do not know whether that means domestic as distinguished from foreign, domestic as distinguished from manufacturing, or domestic as distinguished from public or municipal. It would be in the interest of clearness if the word "domestic," at the top of page 21, should be made clear.

### STATEMENT OF Z. V. TAYLOR

Mr. TAYLOR. Mr. Chairman, a gentleman addressed you a moment ago for thirty seconds on Section e. Did I understand that that closed the discussion as to that particular section?

The CHAIRMAN. No; it did not. I said he could have five minutes.

Mr. TAYLOR. I would like to have two minutes. It seems as if the purpose of this, as I read it, is to pass this tax on, as some one has said, to the consumer. About that we have nothing to say. It seems that the object of the draftsman of the bill was to exempt the companies furnishing this service from any further tax other than the taxes that have been imposed generally in the bill, and it appears to me that he had this in mind when he drew this provision:

"Provided, That an expense incurred by any person, corporation, partnership or association in the furnishing of such power, light, heat or telephone service for its own use shall not be subject to this tax."

I am not clear in my own mind what "for its own use" means. Is "for its own use" the purpose for which the corporation was organized in distributing it or is it for its own use as it is consumed?

Senator SMOOT. You are a man, perhaps, who has been interested in the generating of electricity?

Mr. TAYLOR. Yes, sir.

Senator SMOOT. You know what it means, and we all know what it means. It means for that amount of electric power that is used by the company for the purpose of their own private use.

Mr. TAYLOR. And not for the purpose of resale?

Senator SMOOT. Certainly not.

Mr. TAYLOR. Then, gentlemen, it seems that this is quite a burdensome tax, and I will ask you to give me just about a moment on that.

In addition to all the war taxes that are levied on these corporations, to say that they shall pay 5 per cent, practically, of their gross revenue is indeed quite a hardship, for the electric light and power business is different from almost any other in that it takes $5 expenditure in capital to get $1 in gross revenue. When you take from the gross revenue 5 per cent as a tax upon this particular industry it does seem to me that it is a hardship indeed.

Senator THOMAS. I wish you would point out some item of tax here that is not burdensome.

Mr. TAYLOR. That would be difficult for any one.

Senator THOMAS. I think it would.

Mr. TAYLOR. But why should this particular industry be burdened more than any other corporation? I seem to have made myself clear at least.

The CHAIRMAN. We are much obliged to you. I think we catch your point.

The Sub-section e, in Section 500 of the bill, alluded to, begins the list of taxes on electrical industries, such as power, light, heat, telephones, etc. The Sub-sections a, b and c deal with other public utilities, such as street railways, express, etc. In broad terms, the taxes proposed under Sub-section e, etc., are as follows:

A tax of 5 per cent for electric power for *"domestic"* uses and of the amount paid for light or heat; a tax of 5 per cent of the amount paid for telephone service by subscribers exclusive of the amounts paid for toll or long-distance calls, provided that any expense incurred by any person, corporation, partnership or association in furnishing such power, light, heat or telephone service for its own use shall not be subject to this tax; a tax of 5 cents upon each dispatch, message or conversation of any telegraph or telephone line for which a charge of 15 cents or more is imposed. The latter provision is that only one tax shall be imposed no matter how many lines are used.

## HIGHER RATES FAVORED BY OHIO NEW-BUSINESS MEN

### Ways of Increasing Gross or Decreasing Expenses Considered—Power Schedules Raised—Help the Government Loan

The usual discussions dealing with details of selling had little part in the convention of the new-business men of the Ohio Electric Light Association at Youngstown, May 16. The thoughts of delegates were centered on the problem of maintaining satisfactory net revenues by increasing gross or decreasing expenses or both.

The ideas used for increasing gross revenue are numerous. Connected loads are being checked to catch heretofore disregarded increases on systems where the demand is taken as a percentage of the connected load; demand meters are being installed in places where other and less accurate methods prevailed before; short-term power contracts are written in preference to long-term contracts with the expectation that better rates may prevail a short time hence.

But none of these things nor the savings in operation which are being effected are sufficient to stem the tide, and a strong tendency toward increasing rates is very obvious. In fact, several companies have filed schedules for increases with the Ohio commission. These will be effective within less than two months and in nearly all cases will affect medium and large power business and in some cases commercial lighting business. No increases in residential rates seem immediately necessary.

The general policy in these increases is to let the prevailing rate per unit of energy stand and to effect the increase by wiping out prompt payment discounts, by increasing the hours' use of demand on the first and second steps of demand and energy schedules, by changing from connected load to demand basis for fixing service charge, and by inserting and enforcing coal clauses.

The amount that rates must be raised is an open question, but the prevailing idea is to make the entire change to the higher rate level at one step and thus avoid the disturbances which gradual increases would foment.

Increases specifically mentioned will amount to from 1.8 to 5 mills per kilowatt-hour on power contracts.

Opinion on the advisability of effecting economies at the expense of commercial departments was divided. Some companies have reduced forces as much as 50 per cent; others are curtailing publicity expenditures.

There is a solid group, however, which is preaching "business as usual" to its communities and is setting itself up as an example, feeling that a few hundred dollars saved by cutting sales forces is a small item compared with the impression created. The sentiment of this group of properties was well expressed by T. O. Kennedy of the Massillon Electric & Gas Company, who said that the present economy wave is temporary.

Mr. Kennedy added that the government's war financing need not be alarming if it is carried quickly to a conclusion. Pending completion of the government financing private financing will be difficult, but with the government loan placed it will be possible to sell utility securities. He urged each man to speed the government's financial program.

Three papers were presented. C. H. Felker, Columbus, analyzed ways and means of promoting appliance sales. The discussion showed a marked tendency by central stations to favor forced promotion of appliance business involving minimum additional investment.

T. O. Kennedy, Massillon, related experiences in selling $125,000 of the company's stock to employees and the public. Several companies are planning campaigns.

C. I. Crippen, Youngstown, discussed commercial aspects of the electric arc furnace load.

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## MEDAL OF HONOR AWARDED BY INSTITUTE OF RADIO ENGINEERS

### Given to Edwin H. Armstrong for Work in Connection with Regenerative Amplification and Oscillation by Means of Vacuum-Tube Relay

The "medal of honor" of the Institute of Radio Engineers, described and illustrated in the issue of the ELECTRICAL WORLD for May 5, 1917, page 864, has been awarded for 1917 to Edwin H. Armstrong for his work in connection with regenerative amplification and oscillation by means of the vacuum-tube relay.

The specific publications on the basis of which the award is made were printed in the ELECTRICAL WORLD for Dec. 12, 1914, and in the *Proceedings* of the Institute of Radio Engineers for September, 1915. The full development on which the award was based was specifically included in the latter publication and has found important application in the field.

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## SUBSCRIPTIONS TO THE NATION'S "LIBERTY LOAN"

### Westinghouse Electric & Manufacturing Company Takes $2,500,000, Bell Companies $5,000,000, and H. M. Byllesby & Co. $500,000

Among the subscriptions announced to the great "liberty loan" of the government are the following:

Westinghouse Electric & Manufacturing Company, $2,500,000, one-half to be bought in New York and one-half in Pittsburgh. The company has made arrangements whereby its 30,000 employees may subscribe.

Operating companies of the American Telephone & Telegraph system, $5,000,000.

H. M. Byllesby & Company, $500,000.

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## MOBILIZATION OF UTILITIES IN GREATER NEW YORK

### Chairman Straus of Public Service Commission Calls Meeting of Operators to Bring About Effective Co-operation

Chairman Oscar S. Straus of the New York Public Service Commission, First District, called a meeting of public utility representatives on the afternoon of May 17 to formulate plans for active and effective co-operation in measures made necessary by the war.

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## Illuminating Engineering Society Convention

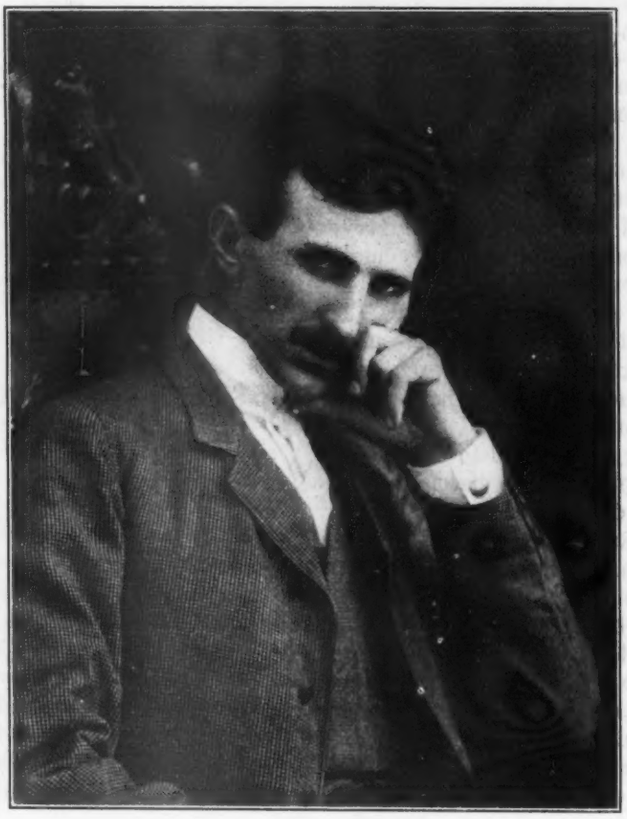
After careful consideration of the national emergency, the council of the Illuminating Engineering Society decided on May 10 to abandon the 1917 annual convention. The committee on papers was instructed to proceed with the arrangements for the convention papers and discussions. These will be published in the *Transactions*.

# NIKOLA TESLA BECOMES THE RECIPIENT OF EDISON MEDAL

## Presentation of Award for Early Original Work and Tributes to the Inventor—New A. I. E. E. Officers

Presentation of the Edison medal to Nikola Tesla and formal report upon the newly elected officers were the announced features of the annual meeting of the American Institute of Electrical Engineers in New York on the evening of May 18.

As stated previously in the ELECTRICAL WORLD, the Edison medal is presented to Mr. Tesla for "early original work in polyphase and high-frequency electric currents." Dr. A. E. Kennelly as chairman of the Edison medal committee outlined the origin and purpose of this honor and gave a brief history of past awards.



Nikola Tesla

Charles A. Terry, whose subject was a presentation of historical facts regarding the Tesla patents, contributions to the arts, etc., said in part:

### MR. TERRY'S TRIBUTE TO TESLA

"It is the God-given desire to accomplish and to give that has produced the Michael Angelos, Galileos, the Sir Christopher Wrens, the Livingstones, Newtons, Franklins, Westinghouses, Edisons and scores of other makers of history—men whose names we retain in affectionate remembrance because they earnestly responded to the call from within and by patient toil conceived thoughts and discovered things of value which they promulgated for the benefit of their fellow men. Twenty-nine years ago this month there was presented before this Institute a paper of unusual import. It is entitled 'A New System of Alternate-Current Motors and Transformers.' The author, Nikola Tesla, was then only thirty-one years of age and had been for only four years a resident of this country. His early life was spent near his birthplace not far from the eastern Adriatic coast. His father, a Greek clergyman, and his mother, herself of an inventive mind, secured for their young son a comprehensive training in mathematics, physics and philosophy. At the age of twenty-two he had completed his studies in engineering at the Polytechnic School in Grätz and also a course in the University of Prague, and in 1881 he began his practical work at Budapest. In 1883 he was at Strasbourg, engaged in completing the lighting of a newly erected railway station. Shortly after finishing this undertaking he came to the United States.

"Throughout all these years his desire had been to find an opportunity to demonstrate the truth of a conviction which became fixed in his mind while studying direct-current motors in school at Grätz in 1878. The conviction was that it should be possible to create a rotating magnetic field without the use of commutators. While at Strasbourg Tesla had succeeded in producing the rotation of a pivoted iron disk placed in a coil traversed by alternating currents, a steel bar being projected into the coil in the neighborhood of the disk. His conception of the reason for this rotation at that time was that a lag occurred in the subsidence of the magnetism of both the disk and the steel bar between successive current waves, and that the mutual repulsions caused the disk to revolve. By some fortunate process of reasoning he conceived while in Budapest in 1882 that by using two or more out-of-phase alternating currents respectively passing through geometrically displaced coils it would be possible to develop his long-sought progressively shifting magnetic field.

"Lack of funds and facilities for working out his theory compelled still further postponement, but in 1885 Tesla had the good fortune to interest men of means in a direct-current arc light which he had devised, and subsequently a laboratory was equipped for him in Liberty Street, New York, and here at last he found opportunity to demonstrate the correctness of his long-cherished theory. In 1887 he was able to exhibit to his business associates and to Prof. William A. Anthony, whose expert opinion they sought, motors having such progressively shifting fields without the use of commutators as he had foreseen nine years before.

"Having thus demonstrated the correctness of his theory and the feasibility of its application, it remained for Tesla to work out various practical methods of applying the principle, and the rapidity and wonderful way in which he surrounded the entire field of constant-speed, synchronous, induction and split-phase motors is beautifully set forth in his paper of May 18 and in the numerous patents issued May 1, 1888, and succeeding years, covering the forms of electric motors, which have since become the almost universal means for transforming the energy of alternating currents into mechanical energy.

"It is somewhat difficult to eliminate from our minds the developments of the last thirty years which have now become every-day features of the electrical industry and to realize the meagerness of the then existing knowledge of alternating-current phenomena. The com-

mercial use of alternating-current systems of distribution was then scarcely two years old. The Gaulard & Gibbs system of series transformers had been used abroad in a limited way for a slightly longer period, but the multiple-arc system based upon the so-called 'Stanley rule,' which initiated the great development of the present system, was not put in practical operation in the pioneer Great Barrington plant until March, 1886. It was then recognized that while the alternating current possessed wonderful possibilities for electrical distribution for lighting purposes, two almost necessary devices were lacking to render it a complete success, one a meter, the other a power motor. Prof. Elihu Thomson promptly devised a successful form of meter, the motive portion of which comprised a laminated field and armature, the coils of the latter being periodically close-circuited during revolution by a commutator. To fill the demand for a power motor, however, the most promising device then suggested was a series commutator motor with laminated field and armature cores, but no satisfactory results had been obtained. Such was the situation when Tesla's achievement was announced in the Institute paper to which reference has been made.

"Among the first to recognize the immense impor-

tance of Mr. Tesla's motors were Mr. Westinghouse and his advisers, T. B. Kerr, Mr. Byllesby, Mr. Shallenberger and Mr. Schmid, and Mr. Westinghouse secured an option which shortly resulted in the purchase of the patents, thus bringing under one ownership the alternating-current transformer system of distribution and the Tesla motor. It is interesting to note here that Mr. Shallenberger had about two weeks before the publication of the Tesla patents independently devised an alternating-current meter the principle of operation of which was that of the Tesla motor, and whatever might have been Mr. Shallenberger's natural disappointment upon finding himself thus anticipated, he at once recognized that to Mr. Tesla belonged the honor of being the first to solve the great fundamental problem of an alternating-current motor. A warm friendship between these two men began at once and continued through Mr. Shallenberger's life, and Mr. Tesla rejoiced to accord to Mr. Shallenberger full credit for the latter's brilliant work in producing what is now the standard meter for alternating currents.

"Owing in a measure to the circumstance that the then prevailing rate of alteration of the alternating-current system was 16,000, the commercial introduction of Tesla motors was somewhat retarded during the first few years, that rate being found less adapted to the motor work than a lower rate. To-day, however, wherever alternating-current systems are used Tesla motors abound. Without such motors the alternating-current system would have remained seriously restricted in its use.

"It will be appropriate to refer to the opinion of Judge Townsend of the United States Circuit Court, rendered in August, 1900, from which I quote the following: 'The Tesla discovery for which these patents were granted revolutionized the art of electrical power transmission, as well demonstrated in the record from both judicial and scientific standpoints.' "

Mr. Terry went on to enumerate Tesla's experimental work in connection with wireless transmission of power and the control of the movements of torpedoes and boats, as well as his contributions in the field of the Roentgen ray, his various electrical inventions, and the bladeless steam turbine for which commercial success is hoped.

B. A. Behrend, in a tribute to Tesla, said:

### TRIBUTE OF B. A. BEHREND

"By an extraordinary coincidence, it is exactly twenty-nine years ago, to the very day and hour, that there stood before this Institute Nikola Tesla, and he read a description of his great discovery of the generation and utilization of polyphase alternating currents. He left nothing to be done for those who followed him. His paper contained the skeleton even of the mathematical theory.

"Three years later, in 1891, there was given the first great demonstration, by Swiss engineers, of the transmission of power at 30,000 volts from Lauffen to Frankfort by means of Mr. Tesla's system. A few years later this was followed by the development of the Cataract Construction Company, under the presidency of our member, Edward D. Adams, and with the aid of the engineers of the Westinghouse company. It is interesting to recall here to-night that in Lord Kelvin's report to Mr. Adams, Lord Kelvin recommended the use of direct current for the development of power at Niagara Falls and for its transmission to Buffalo.

"The basis for the theory of the operating characteristics of Mr. Tesla's rotating-field induction motor, so necessary to its practical development, was laid by the brilliant French savant Prof. André Blondel, and by Professor Kapp of Birmingham. It fell to my lot to complete their work and to co-ordinate—by means of the simple 'circle diagram'—the somewhat mysterious and complex experimental phenomena. As this was done twenty-one years ago, it is particularly pleasing to me, upon the coming of age of this now universally accepted theory—tried out by application to several million horsepower of machines operating in our great industries—to pay my tribute to the inventor of the motor and the system which have made possible the electric transmission of energy. His name marks an epoch in the advance of electrical science. From that work has sprung a revolution in the electrical art."

President H. W. Buck was scheduled to present the medal to Tesla.

### ELECTION OF OFFICERS

The newly elected officers, who were the directors' nominees, are: President, E. W. Rice, Jr., Schenectady, N. Y.; vice-presidents, Frederick Bedell, Ithaca, N. Y.; John H. Finney, Washington, D. C., and A. S. McAllister, New York; managers, Walter A. Hall, West Lynn, Mass.; E. H. Martindale, Cleveland, Ohio; William A. Del Mar, New York, and Wilfred Sykes, Pittsburgh, Pa.; treasurer, George A. Hamilton, Elizabeth, N. J.

# TAX US ON NET PROFITS BUT LET POSTAL RATES ALONE

## James H. McGraw Sets Forth Willingness of Publishers to Pay Full Share of War Cost—Injustice of Proposed Post Office Increase

Under the title of "Our Turn to Be Regulated" we printed some months ago an editorial putting before our readers the unfairness of a proposed increase in second-class postage rates then before Congress as the Randall bill. Congress voted down the measure at this time as unsound. The proposed change in second-class rates is now before Congress as a part of a war revenue measure, proposed this time not to increase the revenues of the Post Office Department, but in the form of a tax on publishers to raise funds to carry on the war. That the provisions of the bill may be understood and that the fight which the publishers are making on this unfair and drastic tax may not be misconstrued as unpatriotic, we print below a letter from James H. McGraw, president of the McGraw-Hill Publishing Company, Inc. The publishers of the ELECTRICAL WORLD wish to meet their obligations as citizens and be taxed on net profits, but they do object to a revenue bill which not only takes the fruit but kills the tree.

To Our Editors:

I don't want to be misunderstood in writing this letter. Our company will pay its full share of the cost of the war we have just entered. Moreover, I believe that our organization can meet any emergency that comes to it and that it can absorb by extra effort and extra watchfulness new burdens put upon us. Certainly, as publishers we have had to meet many drastic situations with the increased costs of paper, ink and printing, and general operating costs rising.

But we have about reached the limit, and the proposed increase of more than 300 per cent in the cost of mailing our periodicals is a blow at our ability really to perform the service which it is the business of our kind of papers to perform.

The ten engineering and business journals which make up our properties are read each week by half a million men in our industries. When I think of our business I think of our readers. We start with them. Our fundamental strength lies in helping them do their work. We have an important place in the present crisis in the industries which each of our papers represents. We have made papers of serious purpose, journals which do more than report news and informing technical material. Ours is the function of leadership in our industries—a leadership which comes from close contact with our respective fields and the willingness to take direct responsibility for the advance of our industries.

### A HEAVY HANDICAP

The proposed postal increase will seriously handicap us in this work. I wish our editors would make this clear to their respective fields. We need to have our reasons for opposing the postage increase fully understood so that any plans later necessary to meet the outcome of the present legislation will not be misconstrued.

The new tax measure as proposed assesses heavy penalties on the publishing business. First we are subject to a war tax on net profits and individual income. To this we do not object. We realize that the costs of carrying on the war must be assessed on going business. But the proposed legislation singles out and penalizes the publishers especially as users of the government post office machinery. Drastic increases in second-class postage and first-class postage vitally affect our business. Last year our company paid $75,000 for second-class postage. Under the proposed increases we will have to pay anywhere from 250 per cent to 364 per cent more proportionally, depending upon the journals. On the average we would be required to pay three times $75,000 for second-class postage alone. Moreover, the proposed increases in first-class postage will increase our present postage by $35,000.

I pass over the business facts briefly. The fact that the proposed increase will wipe some publishers out of business is well known. I pass over the fact that the increase has been voted down before as unsound. I pass over the fact that the drastic postage increase if put through makes impossible the chance for taxable profits and so defeats its very purpose. I pass over these obviously big facts because of what to me seems a deeper and more significant fact—a misconception of the purposes of technical and business journalism on the part of our Congressmen.

### READY TO SERVE THE GOVERNMENT

I need only point to our papers to-day to explain what I mean. Our journals to-day stand ready as an arm of the government to put the needs of the government before our industries. The National Council of Defense and the groups of business men on advisory boards recognize the value and ask for the assistance of the business press in furthering the government's plans. We are glad to do it. We have taken the initiative to make closer co-operation possible, so that every thinking man in the industry may know what he can do and how he can do it. And then the government turns about and imposes a tax that means the complete demoralization of the present machinery of mailing their needed information to our industries.

At a time when the technical and business press have a supreme opportunity for service to their readers, and when they are actively working for the nation's good in spreading the news and detail knowledge of how to meet this great crisis in our government, one branch of our government, unthinkingly we must believe, makes that service impossible or restricts its usefulness. At a time when every man in every industry should be getting an understanding of his personal work in his industry, the government which is calling him cuts the wire that takes the message to him.

I repeat, we stand ready to do our share in meeting war taxes. We also want our function understood. The reader finds in the editorial pages of our technical and business papers how he can get the thing done he most needs to do—the editors report and interpret for him the news and technical advance of the industry. The reader finds in the advertising section machinery and appliances which will help him get the thing done—the manufacturers tell him.

Some journals make phrases that urge to action. They have their place. Our journals have the opportunity to show how to put plans into action. No more important task faces the nation.

Let us have our industries and our government understand us better that we may serve to better purpose.

JAMES H. MCGRAW.

# LOS ANGELES POWER CONTRACT BETWEEN CITY AND COMPANIES

## Terms of Agreement Covering Sale of Distributing Systems and Energy and Temporary Operating Arrangement—Third Company Invokes Court

The City Council of Los Angeles passed a resolution on April 30, 1917, in connection with an agreement to purchase the distributing systems of the Southern California Edison Company and Pacific Light & Power Corporation in Los Angeles, and the making of a contract for the purchase of power service by the city with the companies for a period of thirty years.

### RESOLUTION OF CITY COUNCIL

After a preamble recounting the agreement on terms of purchase and the temporary operating agreement between the Board of Public Service Commissioners of the city and the companies and their approval by the citizens' committee of fifty, the resolution sets forth that the city and the board are authorized to execute the agreements as soon as practicable after authorization by the voters, and after such other steps as are required by the charter.

The passing of the resolution marks the conclusion of a series of strenuous and tedious negotiations which have extended over a period of eight months. The particulars of the agreement referred to in the resolution are given in the summary hereunder.

### CONTRACT FOR SALE OF DISTRIBUTING SYSTEMS

There are two agreements, first, the main contract providing for the sale of the distributing systems of the Southern California Edison Company and the Pacific Light & Power Corporation to the city, and, second, the purchase of electrical energy by the city from the power companies for a period of thirty years.

This contract provides that the price of the electric distributing systems of the two companies in the city shall be $8,270,000, together with the Railroad Commission's valuation of Westgate district, recently annexed, and the companies' expenditures for extensions and betterments since Jan. 1, 1917; also this amount includes severance damage of $1,145,000, less a deduction on the basis of $21,600 per annum as the result of lessening of said severance damage by the operation of the distributing systems under the temporary agreement. [The temporary agreement is given later in this article.—EDS.]

The purchase price will be subject to further deduction for certain properties outside of the city of Los Angeles included in the price, properties which the companies have decided to retain in order that the city's operations may be confined strictly to within the city limits. Payment for the distributing systems as herein outlined is to be made in cash on or before July 1, 1919.

### CONTRACT FOR SALE OF ENERGY

The city of Los Angeles will purchase from the power companies for a period of ten years all the electrical energy which the city shall require for distribution for all purposes within its corporate limits in excess of the electrical energy which the city may generate from the use of water power at plants now or hereafter owned or controlled by the city; provided that during the ten-year period the minimum annual purchases by the city from the power companies will correspond to a maximum yearly demand of 25,000 hp. at an annual load factor of at least 36 per cent.

"Maximum yearly peak demand" is defined as the average of the three maximum peak loads of fifteen minutes' duration each occurring at any time during the year. The schedule of rates to be charged by the power companies for energy supplied to the city is based entirely upon load-factor conditions.

If the city should acquire new territory by annexation or consolidation, it will not extend its municipal electric distributing system into such added territory or furnish electric service therein unless the company owning and operating the electric distributing system in such territory shall, upon demand of the city, refuse to sell such system to the city for such compensation as shall be fixed by the Railroad Commission.

The city agrees that during a period of fifteen years it will sell to the power companies all or any part of such surplus electrical energy as it may generate at a fair and reasonable price to be agreed upon between the city and the power companies or fixed by the Railroad Commission. The city shall be at liberty to wholesale to others only such part of such surplus energy as the power companies do not purchase. The power companies agree not to sell energy in Los Angeles to other corporations without the consent of the city, except to railroad corporations for their own use.

For an additional period of twenty years the city agrees to purchase from the power companies and the companies agree to sell to the city all electrical energy required by the city for distribution for all purposes within the corporate limits of the city in excess of the electrical energy generated at the plants now or hereafter owned or controlled by the city for the generation of electrical energy from the use of water power, at fair and reasonable rates to be fixed each five years by agreement of the parties or by the Railroad Commission; provided that the rates so fixed shall not be more than would be the total cost to the city, including interest charges, of providing itself with such additional electrical energy by the construction of generating plants in addition to the water power plants. Such cost is to be determined by the Railroad Commission.

It is provided further that the city retains the right and option at any time after the first ten-year period of contract, and after such determination of cost to the city by the Railroad Commission, to terminate the agreement, only, however, with the assent of two-thirds of the qualified voters voting on the question at either a general or special election held at any time after eight years and upon giving the power company two years' notice in writing.

Before the final execution of the agreement referred to in the foregoing resolution, it would be necessary to amend the charter in the city, and this would require the approval of the State Legislature. The Legislature adjourned recently and will not reconvene until Jan. 1, 1919. Consequently the city could not actually take over the electric distributing systems of the two companies until the early part of 1919—about twenty months hence.

### TEMPORARY AGREEMENT

In the meantime the city has completed a power plant with an installed capacity of 22,500 kw. In order that

the city may immediately market the power developed by this first plant, a temporary agreement was entered into by the city with the two companies dated April 30, 1917, the gist of which is as follows:

1. From May 1, 1917, to July 1, 1917, the companies' systems are to be operated on behalf of and for the account and benefit of the city. At the option of the city, the period may be extended two years beyond July 1, 1917, subject to the right of cancellation by the city on three months' notice to the companies. The extension of the period is to be upon resolution of the Board of Public Service Commissioners of the city, approved by a two-thirds vote of the Council, and the cancellation is to be upon the vote of the Public Service Commission, approved by a majority vote of the Council, or by a majority vote of the people under the initiative or otherwise.

2. The companies will distribute the city's electrical energy over their lines to consumers within the city, and furnish all additional electrical energy necessary, subject to a minimum of 25,000 hp., at 36 per cent annual load factor. Rates for company energy are to be the same as in the main contract already described.

3. The maintenance and extensions of the distributing systems and the conduct of the business hereunder shall be subject to a supervising board, consisting of two representatives from the city and two representing companies. If a majority cannot agree, they may select a fifth as arbiter, or on important matters refer to the Railroad Commission.

4. The companies are to have charge and control of all matters pertaining to operation of the distributing system, making all collections from consumers. It is not the intent that the powers of the board of control shall go to the extent of hiring or discharging employees, fixing of salaries or such details of operation.

5. From the amounts collected from consumers the companies will retain as compensation the following:

(a) Interest at the rate of 8 per cent per annum on the purchase price for the distributing systems, namely, $8,270,000, plus the cost of extensions and betterments after Jan. 1, 1917.

(b) Interest at the rate of 6 per cent per annum from May 1 on $130,000 of the severance damage as a result of rendering plant capacity idle. (The remainder of the severance will not have occurred.)

(c) Actual cost of operation and maintenance, including taxes and licenses.

(d) For electrical energy furnished by the companies.

(e) Depreciation allowance at the rate of 3.36 per cent per annum.

The remainder of such collections from consumers shall be paid to the city and a plan is provided under which these payments will be made daily upon estimates to be adjusted monthly.

It is provided, however, that in case the purchase price of the distributing systems be paid by the city within the time and in accordance with the provisions set forth in the purchase agreement, the city shall, at the time of making payment of such purchase price, be entitled to a credit on such purchase price of an amount equivalent to one-fourth of all sums payable to the companies for interest as outlined in (a).

6. The depreciation allowance shall constitute a depreciation fund which is held in trust by the companies and will bear interest at the rate of 4 per cent per annum, accruing for the benefit of the fund. All necessary replacements may be made from such fund. In the event that the city finally purchases the property, the balance remaining in the depreciation fund shall go to the city, but if the properties are not purchased by the city the depreciation fund shall belong to the companies.

7. The city agrees not to parallel the companies' lines during the period of this temporary agreement.

Immediately following the execution of the temporary agreement the two power companies commenced distributing through their systems the power generated by the hydroelectric plant owned by the city of Los Angeles. Appearances seem to indicate that the plan will work out satisfactorily to both parties to the agreement.

However, the third power company in Los Angeles, the Los Angeles Gas & Electric Corporation, has not been a party to the two agreements herein referred to, and immediately following the execution of the temporary agreement this corporation filed an action in the Superior Court requiring the city to show cause why it should not be restrained from continuing the operation of the temporary agreement. The case will probably be set for trial on the question of whether the city shall be restrained from alleged violation of the charter. The arguments in the writ are:

1. That the contract violates the city charter, which forbids the sale, transfer or lease of the aqueduct power without a two-thirds vote of the people.

2. That it violates the section of the charter which requires that the city shall call for bids for the purchase of anything of more than $500 value.

3. That it violates the terms of the public utilities act, which forbids the merger or lease of the property of the two power corporations with the city of Los Angeles without the approval of the State Railroad Commission.

4. That it violates that section of the State constitution which forbids the lenling of the city's credit to any person, firm or corporation because the city guarantees the payment of bills of the two power corporations under the operating agreement.

In the meantime the Southern California Edison Company and Pacific Light & Power Corporation have filed an application with the State Railroad Commission for a determination of whether or not the temporary operating agreement is subject to the commission's jurisdiction, and if the commission determines that it has jurisdiction it is asked to pass immediately upon the validity of the agreement.

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## LOS ANGELES NOW SERVED BY MEANS OF AQUEDUCT POWER

### Private Companies Are Distributing City Energy and Paying City About $2,200 Daily—Bond Election to Be Postponed

Since May 1 power generated on the Los Angeles aqueduct has been turned into the city systems of the Southern California Edison and the Pacific Light & Power companies, which have served as the city's distributing agents. This is being done under the terms of the temporary agreement printed on this page.

At the outset the daily proceeds which the city realized from energy delivered to the power companies were about $2,300, of which the Edison company handled about $1,500 and the Pacific Light & Power about $800. Mayor Woodman proposed that $12,500 be set aside each week from the proceeds to meet interest and sinking fund requirements on the power bonds. He expects that at this rate it will be possible to reduce taxes to be collected by the city for the coming fiscal year about 11 per cent. The Mayor, the city legal department and the City Council on May 9 seemed to agree that it would be well to delay the $12,000,000 power bond issue until later in the year, perhaps September, instead of submitting it on June 5.

## AMERICAN CAPITAL IN AUSTRALIAN COMPANY

### Lee, Higginson & Company Purchase of Bonds of Melbourne Electric Company, They Hope, Will Be Followed by Others

A block of $1,250,000 of 6 per cent general mortgage convertible bonds of the Melbourne (Australia) Electric Supply Company, Ltd., was purchased recently by Lee, Higginson & Company, bankers of New York and Boston.

The investment of American capital in an electric utility located so far away as Australia is so unusual that Lee, Higginson & Company were asked whether they regard the transaction as an isolated case or as the forerunner of others. In reply they write to the ELECTRICAL WORLD:

"We purchased this issue of bonds because we believed that it afforded an opportunity for the safe investment of American capital at a rate of interest much higher than prevails in this country for loans of similar security. The transaction did not represent the acquisition of any stock interest at all.

"It has long been our practice to seek issues of bonds which we considered amply secured and which net a fair return for the investor. In doing this it has been necessary at times to go to far distant points, and in some fields we might almost be considered as pioneers.

"Some fifteen or twenty years ago we began buying issues of public utility companies in the Far West which yield more attractive rates on the money invested than properties of similar earning power in the East. It took years of education, however, before the investing public here was willing to buy securities of companies so far afield. Many of the issues which we brought out then, and which we sold with comparative difficulty, are now underlying bonds of large well-known companies, whose junior securities are so well known that it is hard to realize that people a few years ago had hesitated in their purchase.

"The continuation of the war, together with the British treasury regulation prohibiting almost entirely the raising of new capital within the British Isles, caused a situation in regard to companies that had originally been financed in London of which we thought advantage should be taken by the American investor. The Melbourne company had an enviable record of earnings and its reputation was high. English capital had originally been readily available to it, and if it had not been for the coincidence of the war we never would have had the opportunity to buy this issue.

"You may be interested to know that this offering was remarkably well received here. Although brought out at a time when the investment bond market in this country was poor, the issue was oversubscribed in two days and was disposed of at once at a good premium.

"We hope this will be only one of many similar transactions. The English investor has long been regarded as a keen judge of securities, and ordinarily he is satisfied with a lower rate of interest on his money than are we in this country. It is therefore a distinct opportunity for us to be able to buy the securities with which he is familiar and of which he approves at rates of interest better than we are accustomed to receive."

The bonds were offered to the public at 96.75 and interest, yielding 6.75 per cent interest. They are convertible into either preference or ordinary stock.

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## MOTION PICTURES EFFECTIVE IN IMPRESSING SAFETY WORK

### Underwriters' Laboratories Develop Films for Use by Electrical Inspectors and Others to Promote Care in Fire Prevention

The Underwriters' Laboratories have provided themselves with a supply of motion pictures for use by electrical inspectors and others in safety publicity work. These pictures are available without charge to officials, organizations and individuals co-operating in the maintenance of suitable standards of protection against fire and accident. While the pictures include other subjects than electrical testing, there is enough of this to make them suitable for electrical men. There are shown tests on switches and sockets, wires, cords, conduits and fuses, and various other things employed in domestic and industrial applications of electricity.

It is not undertaken, of course, to show all of the tests that the Underwriters make on any given product; the pictures cover only parts of the work that could be photographed rather easily and that have been found to be interesting to the layman as well as the engineer. A typewritten lecture is furnished when it is desired. This lecture can be used to describe the various scenes on the films as they are projected, and there is also suitable matter for use by the lecturer in leading up to the pictures.

The laboratories have other motion pictures which are of a non-technical, human-interest sort, and these are likewise available for meetings arranged for safety publicity. One of these is a two-reel feature and the other a three-reel picture. The two-reel film was made for the laboratories by the Essanay Film Manufacturing Company. Co-operation of the Chicago Bureau of Fire Prevention and Public Safety and the Chicago fire and police departments made it possible to include scenes which cannot be obtained for commercial films. The other of these two subjects was obtained through the courtesy of the New York City fire department.

Applications for the pictures may be made to the Chicago, New York, Boston or Pittsburgh offices of the Underwriters' Laboratories.

MOTION PICTURES THAT AID IN THE SAFETY MOVEMENT

# *Commission Rulings*

**Important decisions of various state bodies involving or affecting electric light and power utilities.**

**Potomac Electric Power Bonds Authorized.**—The Public Utilities Commission of the District of Columbia has authorized the issue of $1,047,500 Potomac Electric Power Company general improvement 6 per cent debenture bonds. The company is ordered to sell the bonds "at the highest obtainable price under such conditions of sale as may be approved by the commission." The order also provides that the certificate of authority "is not to be construed as a certification by this commission of the sufficiency of the security for the said bonds or for any bonds issued by this company, but is understood to mean that the company may apply, and is required under the penalties prescribed in the public utilities law of the District of Columbia to apply, the proceeds from the sale of the said bonds to the purposes specified in the order."

**Avoid Economic Waste in Service Extensions.**—In a case arising from an application by a consumer at Tamagua for gas service from the Eastern Pennsylvania Light, Heat & Power Company the Public Service Commission of Pennsylvania holds: "The mere fact of having corporate rights and authority to exercise the same within a borough is not in and of itself a sufficient and compelling reason, under all circumstances and conditions, why a public service company should be required to extend its service to any portion of the town on the application of a prospective consumer within the borders of the municipality. There should appear in the petition for the proposed extension of facilities some evidence that the service desired contains some elements of remuneration within a reasonable period of time, and that if granted, it would not prove chiefly or wholly an economic waste."

**Modification in San Joaquin Case.**—The California Railroad Commission has issued an order modifying the rates, rules and regulations of the San Joaquin Light & Power Corporation. More than a year ago the commission decided the San Joaquin case. The modifications follow a proceeding initiated by the commission on its own motion to rectify informal complaints made by consumers and by the company. The main issues were concerned with the price to be paid and the method of payment by the company for transformers which the commission ordered it to buy from consumers, and with the effect of the use of maximum-demand meters and the price to be charged by the company for off-pumping-season service for agricultural consumers. The commission now fixes uniform prices to be paid for the various types to all consumers. The basis is the price that the company would be compelled to pay for transformers at present, new, less depreciation at the rate of 5 per cent a year. Cost is to be determined as installed on the consumer's pole. Depreciation is based upon an assumed average life of twenty years. Six per cent interest is to be paid until final payment. The company from May 1 last year to Feb. 20 of this year bought 1280 transformers, or 37 per cent of the 3542 owned at the first date by the power users. The commission now orders higher prices than those proposed by the company for transformers not considered by it to be standard. Another controversy adjusted by the commission was as to the effect of the use of maximum-demand meters. Another cause of complaint was in regard to a rate for pumping for domestic uses during the off irrigation season, and the present order provides such a reasonable rate. Other matters connected with revenue for rural service and with pumping service are adjusted.

**Rates in Quincy Decided by Illinois Commission.**—In the case affecting the Quincy Gas, Electric & Heating Company the Illinois Public Utilities Commission has rendered a decision, some of the main points of which are: The company was ordered to set aside annually $12,000 to meet accruing depreciation in its gas properties and $25,000 annually to meet accruing depreciation in electric properties. No valuation of properties was announced. No rate of return was announced. The commission's rates differ somewhat from certain compromise rates which the company offered about a year ago, in that the commission's gas rates are higher than the company's tender, whereas the commission's electric rates are somewhat lower than the company's offer. Although the total reduction in the company's revenue amounts to about $34,000 annually on a basis of the existing rates, there is not such a saving to the consumers on a basis of the compromise rates. The rates announced by the commission will probably produce an annual revenue of $10,000 less than the company's compromise offer. The company has accepted the rates and agreed to place them in effect as of May 1, 1917. The new schedule of electric rates is as follows: Residential lighting—For the first 25 kw.-hr. used per month, 9 cents per kilowatt-hour; for all over 25 kw.-hr., 6 cents; minimum bill per month per meter, 75 cents. Commercial lighting—For the first thirty hours' use of the maximum demand, 9 cents; for the next thirty hours' use, 6 cents; for all over sixty hours' use, 3 cents; minimum bill per month per meter, $1. Alternating-current power service—For the first 15 kw.-hr. used per month for each horsepower of demand, 6 cents; for the next 1000 kw.-hr., 2 cents; for the next 1000 kw.-hr., 1½ cents; for the next 14,000 kw.-hr., 0.75 cent; for all in excess of above, 0.54 cent; minimum bill per horsepower, 75 cents. The total annual reduction in electric revenue is estimated at $26,000.

# *Recent Court Decisions*

**Findings of higher courts in legal cases involving electric light, power and other public-utility companies.**

**Review of Commission Findings.**—It was not intended that the courts should interfere with the public service commissions or review their determinations further than is necessary to keep them within the law and to protect the constitutional rights of the corporations over which they are given control, according to the Appellate Division of the New York Supreme Court (164 N.Y.S. 310).

**Right of Utility to Acquire Public Land.**—Lands, although acquired by a public commission, if not acquired for public use, are still subject to condemnation, it was held by the Appellate Division of the New York Supreme Court (164 N.Y.S. 430). The law providing that forest preserves shall be forever kept wild forest land, applying only to "lands now owned or hereafter acquired, does not affect the right of a public service corporation or of the State to acquire the lands."

**Right of Property Owners Regarding Tree Trimming.**—While the owner of property in front of which trees are grown and standing has only a qualified or limited interest in them, an interest subject and subordinate to the rights of the city to trim and remove the trees whenever the public interests require such action, if a person injures such trees without lawful right or authority, the owner can recover such damages as he may be able to show he has suffered by reason of any depreciation in the value of his property occasioned by the injury to the trees, the District Court of Appeal, Third District, California, held (164 P. 35). Cities and towns are empowered, as agents of the State, to grant to public utility corporations, such as those engaged in the distribution of water, gas, electricity or the transmission of telegrams, etc., the right to use the streets in a reasonable manner. A telegraph company did not subject itself to an action for damages when it cut the branches of trees growing in front of city property along a sidewalk to clear its wires to prevent interference with their proper operation. A telegraph or telephone corporation, in trimming or severing the branches of trees to prevent contact of wires therewith, can do no more than is necessary for the proper and efficient working of wires without subjecting itself to civil liability for damages. In an action by property owners against a telegraph company for damages caused by the company cutting off the branches of trees in front of plaintiffs' property to clear its wires, the burden was on plaintiffs to show either that it was entirely unnecessary to remove any branches from the trees or that the company removed more than it had to.

**Old Edison Building Defense Headquarters.**—The old building of the Commonwealth Edison Company, Chicago, 120 West Adams Street, has become the headquarters of the Illinois Council of National Defense. The use of the building has been donated for this purpose by Samuel Insull, chairman of the Illinois council.

**Awards by Franklin Institute.**—The Franklin Institute of Philadelphia, through its committee on science and the arts, has made awards of medals to the following for papers published in its *Journal* for 1916: Ulric Dahlgren, professor of biology, Princeton University; George A. Rankin, late of the Geophysical Laboratory, Carnegie Institution, Washington, D. C.; Prof. A. E. Kennelly, F. H. Archard and A. S. Dana, Massachusetts Institute of Technology, Cambridge, Mass.; John D. Ball, late of the General Electric Company, Schenectady, N. Y., and Dayton C. Miller, professor of physics, Case School of Applied Science, Cleveland.

**Earnings of Ontario Power Company.**—The report of the Ontario Power Company, Niagara Falls, Ont., and the Ontario Transmission Company, Ltd., for 1916, eliminating inter-company payments, shows total sales of power of $2,396,277, less $531,007 for purchased power, or $1,865,270. Government rental was $105,560, leaving gross earnings of $1,759,710. Operating expenses were $233,108; to the net earnings of $1,526,602 there was added $140,162 other income, making a total of $1,666,764. Insurance, taxes and refunding expenses aggregated $185,348; from the balance of $1,481,416 there was deducted $932,718 interest, the surplus earnings therefore being $548,698.

**War Relief for British Professional Classes.**—Lewis B. Stillwell has received from Major Leonard Darwin, chairman of the Professional Classes War Relief Council of Great Britain, a letter expressing in behalf of the council appreciation of the contributions of American engineers. Mr. Stillwell is treasurer of the fund for which subscriptions were solicited by the circular issued on March 10, 1917, signed by seventy-six representative members of national engineering societies in this country. The Farmers' Loan & Trust Company, New York, states that the subscriptions to May 11 aggregated $11,793. This sum has been contributed by 1154 engineers. Mr. Stillwell expresses the hope that, "in view of the fact that we are now actually at war as allies of our British friends, those who have not hitherto contributed will act promptly in aid of this worthy and urgent cause." Major Darwin wrote in his letter: "In the interests of your own country, and in order to safeguard the civilization of the world, you also have been compelled to join this terrible strife, and I am certain that, though our beneficiaries would have been deeply grateful to you in any case, yet it is far pleasanter for them to receive this succor from the hands of an ally. All of them and all of us will ever remember America's help in the hour of our need."

# *Current News and Notes*

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

**Electrical Equipment and Machinery in Sao Paulo.**—United States Consul Charles L. Hoover, Sao Paulo, Brazil, writes that the development of the electrical industry in the two states at present included within the Sao Paulo district—Sao Paulo, except Santos, and Paraná—is well advanced, and all the larger cities, even some of the villages, have modern plants which generate electrical energy for both light and power. Sao Paulo, a modern city of 500,000 inhabitants, has a hydroelectric plant which generates 16,000 kw.

**Bird's Nest in Arc Lamp in Cincinnati.**—Recently C. G. Stander, an employee of the Union Gas & Electric Company of Cincinnati, found that English sparrows had built a nest in an arc lamp. The top of the lamp had been broken so that the birds found a warm place for a home. Evidently the nest which they built was occupied through most of the winter. The birds picked the wires and this interfered with but did not stop the illumination. Attention was thus called to the lamp, and investigation showed the presence of the nest, which had been built so as to fill part of the interior. The birds had not been harmed by their experience.

**W. D'A. Ryan Presented with Loving Cup.**—W. D'A. Ryan has been presented by the people of San Francisco with a silver loving cup as a token of appreciation of his work in lighting the exposition and creating the "Path of Gold" on Market Street. The cup, purchased through popular subscription, is surmounted by two small replicas of the artistic standards of the "Path of Gold" lighting system and stands upon a base of California redwood burl. Upon the face of the cup is inscribed, "To D'Arcy Ryan in recognition of his genius in lighting the Panama Pacific International Exposition and the 'Path of Gold.' Presented by the people of San Francisco by popular subscription." The presentation was made at a luncheon on May 9, presided over by John S. Walter, president of the Downtown Association, and attended by about 200 business men. Among the speakers were Charles C. Moore, president of the exposition; John A. Britton, vice-president and general manager Pacific Gas & Electric Company, and Edward L. Nolan, chairman of the supervisors' lighting committee.

**Electric Plant in Bocas del Toro.**—The government of Panama has authorized the Municipal Council of Bocas del Toro to contract a loan with a domestic banking house for $20,000, to be used for the purpose of establishing an electric lighting plant.

**Centralization of Ownership in Germany.**—An article on "Long-Distance Supply of Electricity in Germany," from United States Consul Charles S. Winans, Nuremberg, dated Dec. 29, 1916, quotes a report by Wilhelm Beck, Steglitz, which concludes: "Through the uniform electrical supply of whole countries a compensation in the demand for power will be assured, with the possibility of utilizing all plants more uniformly and economically than before, when many local works at times had excessive demands made upon them while at other times they had to supply only a small quantity of energy. Regardless of other savings in a comprehensive organization of electrical production and distribution, one may not, from the standpoint of political economy, disregard the circumstances that our natural sources of power and land resources will not be squandered by careless working, but will be exploited in a productive and suitable manner for the general welfare of the country at large."

**Wisconsin Commission Exhibit at State Electrical Convention.**—At the recent convention of the Wisconsin Electrical Association the engineers of the Railroad Commission conducted an exhibit for the commission. The regular inspectors' conference was made to coincide with the convention date, and practically all of the commission's technical force was on hand to show the operating men about the exhibit. A chart gave the commission's service rating in per cent for every gas and electric company. This percentage is determined for every plant according to a plan of grading worked out by the commission, based on adherence to the commission's operating rules. One group of curves in the exhibit was designed to show the necessity of installing all meters indoors. It indicated the harmful effect of temperature changes on the accuracy of many different types of meters. Other curves showed the extent of errors in master meters sent to the commission for test. To show that the rotating standard is not the last word in accuracy, there were set up a potentiometer with primary standards, a galvanometer and a tuning-fork timing device. There was also shown a shop standard that could be used for checking the master meter or rotating standard. Three types of graphic meters were displayed. One display consisted of three current transformers and curves showing operating characteristics of each. About the room were groups of photographs and placards. J. N. Cadby, engineer of the commission, who had charge of the exhibit, stated that at no time during the convention did the exhibit lack interested visitors. It proved, he said, of mutual value to the commission and the plants because of its educational characteristics.

**Pennsylvania Electrical Contractors' Association.**—The annual convention of the Electrical Contractors' Association of the State of Pennsylvania will be held at Philadelphia, June 19, 20 and 21.

**Dallas Electric Club and Jovian League.**—L. A. Ott, vice-president, was in charge of a meeting of the Dallas Electric Club and Jovian League on May 7. E. E. Rossler is the secretary of the association.

**The Society for Electrical Development, Inc.**—A meeting of the Society for Electrical Development, Inc., was held on May 8 at the office of the society in the Engineering Societies Building, 29 West Thirty-ninth Street, New York.

**Illuminating Engineering Society.**—The application of artificial illuminants in black and white and color photography was described by John H. Powrie before the New York Section of the Illuminating Engineering Society on May 10.

**San Francisco Electrical Development and Jovian League.**—At the May 9 meeting of this association W. W. Hanscom described advances in wireless telegraphy, outlining the methods used and the remarkable degree of success which has attended recent improvements.

**Dealer Help Service Furnished by Manufacturers.**—William H. Easton of the Westinghouse Electric & Manufacturing Company spoke on the subject of "Dealer Help Service Furnished by Manufacturers" before the Technical Publicity Association, New York City, on May 10, being followed by Z. M. Hyer, manager of the United Electric Shop, who spoke from the standpoint of the dealer. The subject of conventions and convention exhibits was discussed by Carroll H. Dunning.

**Cincinnati Electric Club Elects Officers.**—On April 16 the Electric Club of Cincinnati elected the following officers for the ensuing year: President, J. A. Breet, district manager Westinghouse Electric & Manufacturing Company; first vice-president, L. T. Milner, district manager Western Electric Company; second vice-president, T. E. Wickham, secretary and treasurer Union Gas & Electric Company; secretary and treasurer, O. B. Marsh, manager Federal Sign System (Electric) Company; board of directors, T. J. Creaghead, president Creaghead Engineering Company; Walter A. Draper, vice-president Cincinnati Traction Company, and W. J. Hanley, district manager General Electric Company.

**Electrical Supply Jobbers' Association of the Pacific Coast.**—The regular quarterly meeting of this association was held at Del Monte on April 26, 27 and 28. A paper on merchandising which was presented by A. W. Childs at the recent Riverside convention of the N. E. L. A. was read and discussed in detail. The question of how best to handle slow-moving stock received careful consideration, and there was also a debate on the question of adopting a uniform vacation period. This last subject is one of considerable importance in effecting economies and is the logical successor to the agreement about suspending business between 12 and 1 o'clock, which the association members recently approved and which resulted in a considerable saving to those indorsing it.

## *Associations and Societies*

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

**New York Section of the A. S. M. E.**—The development of the poppet-valve steam engine, with special reference to its present status in the United States, was the subject of an address made on May 8 by Siegfried Rosensweig before a New York meeting of the American Society of Mechanical Engineers.

**Kansas City Jovian League.**—The Jovian Electric League of Kansas City held a rejuvenation May 7 at which nine candidates were initiated, the program being under the direction of J. F. Bratney and F. L. Funsten, first and second tribunes. The Electric League was well represented at a dinner May 8 in honor of the city-planning conference, more than 1500 persons, representing about twenty organizations, being present.

**Southwestern Illuminating Society.**—The Southwestern Illuminating Society was organized in Kansas City, Mo., recently, and now has a membership of eighteen firms, including all but one firm showing fixtures or concerned with lighting. So far only Kansas City firms have been invited to join, but the society expects to extend its scope beyond that city. Meetings are held on the first and third Thursdays of each month. The society was organized to develop the industry in the Kansas City section, raise its standards, and educate the men in the business as well as the public. It is believed that the firms themselves have not fully appreciated the opportunities of illumination and what each might do to enhance its dignity and importance. The first definite work taken up has been the educational propaganda with reference to costs. The members contribute their own experience in estimating jobs and keeping accounts. Firms have discovered that they were supplying fixtures at less than cost, and others that they were selling items at about cost, without any charge for service or handling, let alone interest or profit on investment. Eventually a credit interchange bureau will be established. The educational committee is now working out its program for the further help of members and for a series of steps toward the education of the buying public in illuminating matters. This committee consists of R. O. Fritz, E. W. Cowan, Albert Jacobson and Henry C. Forster. The officers of the society are: President, John J. McGee; vice-president, W. T. Flippen; secretary, A. S. Viner, and treasurer, S. P. Russick.

**Pittsburgh Section, A. I. E. E.**—The May meeting of the Pittsburgh Section of the American Institute of Electrical Engineers was held on May 8. Modern warfare was the principal topic of the evening.

**Annual Convention of New England Section of the N. E. L. A.**—The ninth annual convention of the New England Section of the National Electric Light Association will be held at New London, Conn., Sept. 11 to 14 inclusive.

**Electrical Contractors' Association of Massachusetts.**—The next annual meeting of the Electrical Contractors' Association of Massachusetts will be held in September at Worcester, Mass. Further details of this meeting will be announced later.

**Schenectady Section of the A. I. E. E.**—J. B. Taylor addressed the Schenectady Section of the American Institute of Electrical Engineers on May 4 on the subject of "Acoustical Engineering and a Review of the Characteristics of Noise, Speech and Musical Sounds." This lecture was illustrated and some demonstrations were made.

**Electrical Development and Jovian League of San Francisco.**—At the May 2 meeting of this association Prof. Ira W. Howerth of the University of California gave a talk on the industrial significance of university extension courses. This subject has received the careful consideration of the league, and a committee has been appointed to arrange for extension courses on cost accounting, correspondence, etc., which are expected to be of considerable benefit to the members at large.

**New Jersey Electrical Merchants' Association.**—On May 4 the jobbers and dealers of New Jersey formed an organization to be known as the New Jersey Electrical Merchants' Association, with officers as follows: President, S. H. N. Agens, Agens & Company, Newark; vice-president, Meyer Rutkin, Newark; secretary, I. Joffre of Silk City Electrical Supply Company, Paterson; treasurer, Abraham Beller, Eastern Electrical Supply Company, Newark. The executive committee consists of O. Frederick Rost of the Newark Electrical Supply Company and M. Rutkin and Samuel Forster of the Star Electrical Supply Company, Newark.

**St. Louis Jovian Luncheon Meeting.**—Under a plan recently adopted by the St. Louis Jovian League—to turn some of its meetings over to different firms in the city—the Union Electric Light & Power Company had charge of the luncheon meeting on May 8. Short addresses were given by the heads of the electric-service companies' different departments, who described methods of operation and recited various experiences. Among those who spoke were C. S. Ruffner, vice-president; L. H. Egan, general manager; Herman Spoehrer, secretary and treasurer; John Hunter, chief engineer of power plants; J. R. Portnell, distribution engineer; H. W. Eales, electrical engineer; C. E. Michel, office sales manager, and John Abbink, advertising manager. Frank D. Beardslee, general sales manager of the company, presided as chairman.

**N. B. Bertolette** succeeds A. P. McCarthy as local manager for the Philadelphia Suburban Gas & Electric Company at Coatesville, Pa.

**A. P. McCarthy**, Coatesville, Pa., local manager for the Philadelphia Suburban Gas & Electric Company, has been appointed to a similar position for the company at Pottstown.

**James M. Wakeman**, general manager of the Society for Electrical Development, has been confined to his home with appendicitis. At the time of going to press the doctors were hopeful that no operation would be necessary.

**E. H. McHenry** has retired from business, the engineering firm of McHenry & Murray having been dissolved with the mutual consent of the partners. Before forming the partnership in 1913 Mr. McHenry was vice-president of the New York, New Haven & Hartford Railroad Company in charge of engineering, maintenance and construction work, including the original electrification of the road between New York and Stamford and the extension to New Haven now completed.

**G. D. Longmuir**, who has been connected with electric lighting interests in various positions of responsibility in the State of Washington for a number of years, has entered business for himself, being one of the incorporators of the Reliance Electric Company, Tacoma, Wash. Mr. Longmuir rose from electrical engineer to general manager of the property at Prosser, Wash., and when the property was taken over by the Pacific Power & Light Company he remained as manager. Later he was transferred to Pasco, Wash., as district manager for the company in the Columbia River valley.

**E. M. Harvey** of Chicago was recently appointed electrical engineer of the Eastern Wisconsin Electric Company at Sheboygan, Wis., succeeding Carroll H. Shaw, who resigned to become chief engineer of the Minnesota Utilities Company at Chisholm. Mr. Hervey is a graduate of the Massachusetts Institute of Technology and has had an extensive experience in electrical work, having in recent years been with the Chicago Sanitary District as assistant construction superintendent in the electrical department. He has also spent three years with the city of Chicago as electrical engineer.

**T. Norman Jones, Jr.**, has been appointed assistant general manager of the Virginia Railway & Power Company, in charge of the properties in Norfolk, to succeed E. C. Hathaway, resigned. Mr. Jones was born in Richmond, Va., in 1882 and was educated at the University of Virginia. He was associated with the McKay Engineering Company and the United Electric Light & Power Company, Baltimore, and in 1906 entered the employ of the company with which he is now connected as mechanical and electrical engineer. In 1907 he took charge of operation of the Richmond & Chesapeake Bay Railway, returning to the Virginia Railway & Power Company in 1911 as chief engineer of railways, which position he held until his recent promotion.

## *Men of the Industry*

Changes in Personnel and Position—Biographical Notes

**Maxwell C. Maxwell**, formerly superintendent of power and plant and of the tool machine department of the Yale & Towne Manufacturing Company, Stamford, Conn., has been appointed assistant general superintendent of that organization.

**Alfred S. March**, New Brunswick, N. J., has become a member of the Board of Public Utility Commissioners of New Jersey, in accordance with recent appointment by Governor Edge, effective May 1, succeeding John J. Tracy, Jersey City, whose term of office has expired.

**P. D. Kline** has resigned as general manager of the Ogden (Utah), Logan & Idaho Railway Company and is now manager of the La Crosse (Wis.) district of the Wisconsin-Minnesota Light & Power Company, which is operated by the American Public Utilities Company of Grand Rapids, Mich. Mr. Kline was associated with Ogden railway interests for four years, joining the Ogden Rapid Transit Company in February, 1913, as general superintendent. Shortly afterward he became general manager of the system, and when a year or so later the company was merged with the Logan Rapid Transit Company into the Ogden, Logan & Idaho Railway Company he became general manager of the new company. Prior to going to Utah Mr. Kline was general superintendent of the Falkenau Electrical Construction Company of Chicago, where he had full charge of all field construction. In that capacity he installed several large railway systems, lighting systems and a number of large power stations.

**Douglas H. McDougall** of the Toronto (Ontario) Power Company was elected fourth vice-president of the National Electric Light Association at the recent two-day meeting in New York City. Mr. McDougall is very prominent in Canadian electrical activities, being president of the Canadian Electrical Association and treasurer of the Electrical Development Company, the Toronto & Niagara Power Company and the London (Ont.) Electric Company. Mr. McDougall was born in Toronto in 1874. In 1893, after experience in the United States in accounting work, he returned to Toronto as treasurer of the Electrical Development Company of Ontario, Ltd., taking charge of the finances of this company. In 1908 this company was leased to the Toronto Power Company, and Mr. McDougall was appointed assistant to the general manager until, in 1911, the Toronto company purchased the entire stock of the Toronto Electric Light Company and Mr. McDougall was appointed assistant to the manager of the enlarged organization.

**Charles E. Fasoldt**, Rensselaer, N. Y., has been appointed engineer in charge of power lines of the United Traction Company, Albany, succeeding H. J. Childs, resigned.

**Joseph B. Stewart, Jr.**, has been recently appointed assistant to the general manager of the Mahoning & Shenango Railway & Light Company and subsidiary companies, with headquarters at Youngstown, Ohio.

**Harold R. Wilbur**, Lambertville, N. J., has been appointed state manager for the National Utilities Company, operating properties at Lambertville, Newton and Dover, N. J. He has heretofore been local manager for the Lambertville Public Service Company.

**H. E. Brandli**, formerly general manager of the Citizens' Gas, Electric & Heating Company at Mount Vernon, Ill., recently sold by H. L. Doherty & Company to the Frye interests, succeeds Major A. B. Paterson as general manager of the Meridian (Miss.) Light & Railway Company. Mr. Brandli was at one time superintendent of lighting of the Ottumwa (Ia.) Railway & Light Company, going from there in the summer of 1912 to Minot, N. D., as manager of the Consumers' Power Company. A year later he became connected with the Mount Vernon property.

**William Spencer Murray**, as a result of the dissolution of the engineering firm of McHenry & Murray, New Haven, Conn., with the mutual consent of the partners, will hereafter devote his entire time and attention to the interests of the Housatonic Power Company, New Haven, of which he is president. Mr. Murray up to May 1, 1913, when the firm of McHenry & Murray was formed, was electrical engineer for the New York, New Haven & Hartford Railroad Company in the electrification of its New York division. From that time on he was engaged by the railroad in a consulting capacity to direct all of the road's new electrification work. Mr. Murray was born at Annapolis, Md., Aug. 4, 1873. In 1895 he was graduated from Lehigh University and was employed by the Westinghouse Electric & Manufacturing Company, resigning in 1901 to engage in engineering work in Boston. In 1905 he was engaged by the New York, New Haven & Hartford. It was on his recommendation that a single-phase system was adopted for the electrification. This was the first single-phase electrification of any consequence in this country and was the basis for a wide discussion at the time in engineering circles. The success of the system, however, is attested by its enlargement from Stamford to Hartford and beyond.

## Obituary

**John P. Vollmer**, one of the telephone pioneers, died at his home in Lewiston, Idaho, recently in his seventy-first year. Mr. Vollmer, it is understood, built the first telegraph line in Idaho in 1876, and a year or two later built and operated the first practical Bell telephone line on the Pacific Coast.

# REVIEW OF TRADE AND MARKET CONDITIONS

*News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods*

## PROSPECTS OF WAR FOR ELECTRICAL MANUFACTURERS

### German Concerns, Despite Loss of Most Lucrative Market, Have Greatly Increased Earnings and Dividends

Electrical manufacturers, there is no use denying, are to-day very much worried over the future. War has always been associated with disaster, poverty and deficits, not with profits. Business now is excellent, but there is a question concerning how long it will remain good. Nor can there be any doubt that on account of this fearfulness the trade is beginning to react, and there is the possibility that a great reduction in business may result.

That war, however, is to-day of a different nature from what it was in our grandfathers' and great-grandfathers' time there is no disputing. It takes a couple of men working at home to keep one man in the trenches. Business is created, and practically all industries feel a greater demand for their products.

So far as the electrical manufacturers are concerned, the past year and a half has proved sufficiently that big business is a natural adjunct of modern war. True that war was waged in Europe, and the United States was not a party to it. Still, there is probably none that will admit that, even at their worst, conditions in the United States will begin to be so bad as those to be found to-day in Germany. Undoubtedly there war is at its worst. None the less, the German electrical manufacturers have prospered. Their earnings have made remarkable increases and their dividends have been larger, this in spite of the fact that the most lucrative market the German manufacturers had—namely, the export market—was closed to them on the outbreak of hostilities.

In the following extract from the Jan. 3 issue of the *Frankfürter Zeitung* American electrical manufacturers will undoubtedly find much food for thought:

"More than any other German large-scale industry, the electrical industry was already characterized, before the war, by enormously extended works and by a carefully organized financial system which spread its net over half the globe. The industry thus became one of the strongest of the pillars on which German industrial expansion rested, but, because of its international interests, it offered many points of attack in a time of crisis like the present. Yet the industry has not only withstood the onslaughts made upon it but has actually improved its financial position. The remarkable nature of this achievement becomes apparent when it is borne in mind that the industry is cut off from some of its important foreign interests, that these very interests have been endangered by a ruthless policy of persecution, and that the industry has been almost completely deprived of a branch of its activity which is vital to it, namely, its export trade.

"The industry has achieved its successes by reconstructing itself for purposes of war work. The enormous factories, with their exemplary organization and their hosts of skilled workers and technical specialists, have become indispensable centers of war activity.

"But while the net profits have been high, the dividend rates have not been commensurate with them. This is due:

"(1) To the very large sums required for war relief to workers;

"(2) To the need for heavy reserves to cover factories abroad, foreign securities and foreign claims;

"(3) To the necessity for laying by sufficient sums to make good the wear and tear of machinery which the war has worked at exceedingly high pressure, and

"(4) To maintain the strong financial position of the industry, which alone will enable it to organize itself on a fresh peace basis and to win back the spheres of influence at present attacked by the hate-engendered business policy of Germany's enemies.

"It is of the utmost importance for the economic position of Germany after the war that large-scale industries like the electrical industry should make far-sighted provision for the future. The disparity between the net profits and the dividends actually paid to shareholders in the electrical industry is really evidence of strength. In the case of the twenty companies in the accompanying table (having an aggregate capital value of approximately $182,000,000), the net profits rose from 77,465,000 marks (approximately $19,370,000) in 1913 to 84,461,000 marks (approximately $21,115,000) in 1914 and 103,627,000 marks (approximately $25,900,000) in 1915. The amounts written off in each of these years were respectively 27,864,000 marks (approximately $7,000,000), 35,758,000 marks (approximately $8,940,000), and 49,000,000 marks (approximately $12,250,000). The average dividends appear in the table, which also gives some further details for the years 1913, 1914 and 1915.

| Companies | Capital | Dividends, Per Cent 1915 | 1914 | 1913 |
|---|---|---|---|---|
| Allgemeine Elektricitäts-Gesellschaft | $46,000,000 | 12 | 11 | 10 |
| Siemens-Schuckertwerke | 22,500,000 | 10 | 10 | 7½ |
| Bergmann Elektricitäts Werke A.-G. | 11,937,500 | 10 | 5 | 5 |
| Elektricitäts-Lieferungs A.-G. | 7,500,000 | 10 | 10 | 12 |
| Rheinische Schuckertgeschellschaft | 2,750,000 | 5 | 5 | 5 |
| Brown Boveri A.-G., Mannhe.m | 2,250,000 | 10 | 5 | 5 |
| Rheinisch-Westfalisches Elektricitätswerke, A.-G. | 12,500,000 | 8 | 8 | 8 |
| Kraftubertagungswerke Rheinfelden A.-G. | 3,000,000 | 8 | 8 | 8 |
| Deutsch-Ueberseeische Elektricitäts A.-G. | 37,500,000 | 6 | 5 | 11 |
| Hamburgische Elektricitätswerke A.-G. | 6,875,000 | 5 | 11¾ | 8½ |
| Elektricitäts A.-G., formerly H. Poege, Chemnitz | 1,125,000 | 15 | 7½ | 4 |
| Sachsenwerk, Dresden | 1,125,000 | 18 | 10 | 8 |
| Accumulatoren-Fabrik A.-G., Berlin-Hagen | 3,000,000 | 20 | 18 | 20 |
| Hartmann und Braun | 425,000 | 12 | 8 | 10 |
| Voigt und Haffner | 1,250,000 | 12 | 8 | 12 |
| Julius Pintsch A.-G. | 4,500,000 | 8 | 8 | 8 |
| Felten und Guilleaume-Carlswerk A.-G. | 13,750,000 | 11 | 8 | 8 |
| Hackethal Kabelwerke | 1,400,000 | 22 | 16 | 16 |
| Deutsche Kabelwerke | 1,337,500 | 6 | 6 | 8 |
| Kabelwerks Rheydt | 1,250,000 | 30 | 18 | 12 |
| Total | $181,950,000 | 10.4 | 9.35 | 9.12 |

## EFFECT OF ELECTRIC RANGE PRICES ON THE MARKET

### Observations on the Situation Existing Between Manufacturers and Central Station Companies, with Constructive Ideas for Future Advances

That electric range promotion has received a setback there can be no doubt. Just wherein the mistake lies it is difficult to decide. But it is plain that the error was made, because its effects are so apparent. These effects are manifested in the unanimous central station opinion that range prices are too high, while the same impression is not held regarding the prices of other electrical products which have "gone up." In fact, the same men who condemn in loudest language the increasing prices in electric ranges will find plenty of justification for advancing prices of other products, even though they are selling both lines of goods. This seems, therefore, evidence that the range manufacturers have erred. It does not mean necessarily that they have erred in increasing their prices. The advances may be entirely justifiable. But if advances were necessary they made a mistake in not adequately explaining to their central station customers why a range with a given number of pounds of iron, copper, insulating material and resistance wire

should advance a certain degree in price automatically with the advance in the price of its materials.

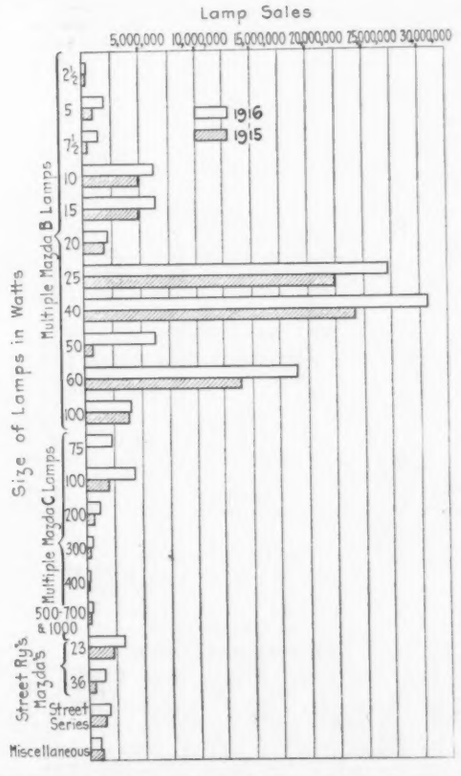
One or the other of these two is the big mistake which has been made. If a further blunder is to be avoided, close co-operation between the manufacturers and the central station will undoubtedly have to be effected so that in the future advances can be made without disrupting the entire retail plan of merchandising. It should be possible, in fact, if the co-operative arrangement were properly handled, to make any necessary advances beneficial to the business of the central station instead of detrimental as they have been heretofore.

One practical way of accomplishing this purpose, and one that has strong support, would be the announcement of price increases further in advance of the date on which the raise is to be effective. This would give central stations a chance to get their house in order. Time is required for that, because it actually takes at least thirty days to plan intelligently and prepare for a good central station selling campaign. Each price advance could be made the occasion for a "buy-before-the-price-goes-up" retail campaign. Then the wavering "prospects" will be won, whereas with the present plan they are lost. This idea is successful in automobile sales; it has proved its worth in vacuum cleaner sales. There seems to be no real reason why it should not be used as the basis of establishing closer co-operation between the range manufacturers and the central stations.

## INCANDESCENT LAMP SALES TOTAL 154,000,000 IN 1916

### Inncrease of 31 Per Cent in Domestic Sales Over Previous Year—40-Watt Size Is Still That in Greatest Demand

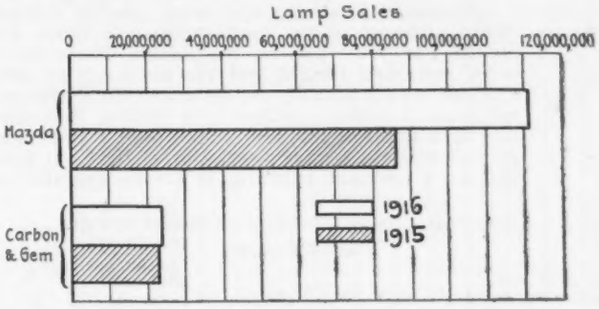
As has been frequently shown in these pages, incandescent lamp sales reached tremendous totals in 1916. Domestic sales in 1916 were 145,000,000, which is 31 per cent,




CLASSIFICATION OF DOMESTIC MAZDA LAMP SALES FOR 1915 AND 1916 ACCORDING TO TYPE AND SIZE

or 35,000,000 lamps, greater than 1915 sales. In addition, over 9,000,000 incandescent lamps were exported in 1916, making total sales for last year of 154,000,000 lamps, in comparison with 116,000,000, the total number of sales that was recorded in 1915.

Of the total 1916 sales, slightly more than 129,000,000 were tungsten-filament, and the remaining 25,000,000 were carbon and graphitized-filament lamps. In 1915, 92,000,000 tungsten-filament lamps and 24,000,000 carbon and graphitized-filament lamps were sold. It would therefore seem




DOMESTIC LAMP SALES FOR 1915 AND 1916 CLASSIFIED ACCORDING TO FILAMENT

from these figures that the sale of carbon and graphitized-filament lamps increased slightly in 1916.

The 40-watt size tungsten lamp for multiple-circuit use continues to be in greatest demand, the 1916 domestic sales of this size being 30,700,000, compared with 24,200,000 in 1915. The next largest domestic sale was in the 25-watt size, of which 27,200,000 were sold in 1916 and 22,400,000 in 1915. The 50-watt size is coming into more general use, the sales having jumped from 708,000 in 1915 to 6,300,000 in 1916.

Almost 9,000,000 gas-filled units were sold in 1916, against slightly more than 3,000,000 in 1915. The 100-watt size has the greatest sale, 4,330,000 being sold in 1916.

There are shown graphically in the accompanying diagram the 1916 and 1915 domestic sales of tungsten lamps, classified according to sizes, and also the tungsten and carbon lamps.

## METAL PRICES STIFFEN

### Buying Has Slackened Off, Awaiting Action of Warring Governments

Since the report of last week prices of various metals have generally stiffened. Buying has slackened off, but it is anticipated that there will be some large buying for future delivery before long. The lead market showed probably the greatest activity of the week.

Copper buyers have been keeping away from the market, and on going to press the general undertone was one of listlessness. Every one seems to be waiting to find out what European governments and the American government intend doing.

Nominal quotations of electrolytic copper on Tuesday were: May, 32.50 cents; June, 31.50 cents; July, 30.5 cents; third quarter, 29 cents; fourth quarter, 28 cents.

NEW YORK METAL MARKET PRICES

| | May 8 Selling Price Bid | May 8 Selling Price Asked | May 15 Selling Price Bid | May 15 Selling Price Asked |
|---|---|---|---|---|
| Copper: | £ s d | | £ s d | |
| London, standard spot | 130 0 0 | | 130 0 0 | |
| Prime Lake | 31.50 to 32.50† | | 32.00 | to 33.00 |
| Electrolytic | 32.50 to 33.00† | | 32.25 | to 32.75 |
| Casting | 29.50 to 30.00† | | 30.87½ | to 31.12½ |
| Copper wire base | 36.50 to 37.50† | | 36.50 | to 37.50 |
| Lead | 9.50 | | 9.50 | |
| Nickel | 50.00 | | 50.00 | |
| Sheet zinc, f.o.b. smelter | 19.00 | | 19.00 | |
| Spelter, spot | 9.30 to 9.42½ | | 9.30 | to 9.55 |
| Tin, straits | 59.50 | | 66.00 | |
| Aluminum, 98 to 99 per cent. | 56.00 to 58.00† | | 56.00 | to 58.00† |

OLD METALS

| | | | |
|---|---|---|---|
| Heavy copper and wire | 26.50 to 27.00 | 27.00 | to 28.00 |
| Brass, heavy | 16.00 to 16.50 | 17.00 | to 18.00 |
| Brass, light | 12.50 to 13.50 | 13.00 | to 14.00 |
| Lead, heavy | 8.00 to 8.25 | 8.50 | to 8.75 |
| Zinc, scrap | 6.50 to 7.25 | 6.50 | to 7.00 |

†Nominal.

# Current Prices of Electrical Supplies

The prices quoted are those prevailing in standard package or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists to contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

## ARMORED CONDUCTORS, FLEXIBLE STEEL

*Single-Conductor*

| B. & S. Size | List, per 1000 Ft. Chicago | N. Y. |
|---|---|---|
| No. 14 solid | $61.00 | $61.00 |
| No. 12 solid | 71.00 | 71.00 |
| No. 10 solid | 90.00 | 90.00 |
| No. 8 solid | 106.00 | 106.00 |
| No. 6 solid | 145.00 | 145.00 |
| No. 10 stranded | 95.00 | 95.00 |
| No. 8 stranded | 115.00 | 115.00 |
| No. 6 stranded | 160.00 | 160.00 |
| No. 4 stranded | 205.00 | 205.00 |
| No. 2 stranded | 266.00 | 266.00 |
| No. 1 stranded | 315.00 | 315.00 |

*Twin-Conductor*

| | | |
|---|---|---|
| No. 14 solid | 104.00 | 104.00 |
| No. 12 solid | 135.00 | 135.00 |
| No. 10 solid | 185.00 | 185.00 |
| No. 8 stranded | 235.00 | 235.00 |
| No. 6 stranded | 370.00 | 370.00 |
| No. 4 stranded | 575.00 | 575.00 |

## DISCOUNT PER 1000 FT.

*Single-Conductor*

| No. 14 solid: | Chicago | N. Y. |
|---|---|---|
| Less than coil | +10% | Net |
| Coil to 1000 ft | —10% | 3% |
| No. 12 solid: | | |
| Less than coil | +10% | Net |
| Coil to 1000 ft | —10% | 3% |

*Twin-Conductor*

| | | |
|---|---|---|
| No. 14 solid: | | |
| Less than coil | +10% | Net |
| Coil to 1000 ft | —10% | 23% |
| No. 12 solid: | | |
| Less than coil | +10% | Net |
| Coil to 1000 ft | —10% | 3% |

## ATTACHMENT PLUGS

| | Std. Pkg. | List Chicago | List N. Y. |
|---|---|---|---|
| Benjamin No. 903 | 100 | $0.25 | $0.25 |
| Hubbell No. 5406 | 250 | .30 | .30 |
| Bryant No. 706 | 100 | .25 | .25 |
| G. E. 50996 | 250 | .22 | .22 |

| Discount | Chicago | N. Y. |
|---|---|---|
| Less than 1/5 std. pkg.: | | |
| Benjamin No. 903 | 12% | 12% |
| Hubbell No. 5406 | +10% | 10% |
| Bryant No. 706 | +20% | List |
| G. E. 50996 | +20% | List |
| 1/5 to std. pkg.: | | |
| Benjamin No. 903 | 20% | 20% |
| Hubbell No. 5406 | 10% | 10% |
| Bryant No. 706 | Net | 15% |
| G. E. 50996 | Net | 15% |
| Std. pkg.: | | |
| Benjamin No. 903 | 44% | 40% |
| Hubbell No. 5406 | 34% | 34% |
| Bryant No. 706 | 30% | 28% |
| G. E. 50996 | Net | 28% |

## BATTERIES, DRY

| Each Net | No. 6 Regular Chicago | No. 6 Regular N. Y. | No. 6 Ignitor Chicago | No. 6 Ignitor N. Y. |
|---|---|---|---|---|
| Less than 12 | $0.35 | $0.35 | $0.35 | $0.35 |
| 12 to 50 | .30 | .30 | .30 | .30 |
| 50 to barrel | .26¼ | .28 | .27½ | .29 |
| Barrel lots | .24¾ | .24 | .25¾ | .25 |

## CONDUIT, METALLIC FLEXIBLE

| Size, In. | Feet per Coil | List per 100 Ft. Chicago | List per 100 Ft. N. Y. |
|---|---|---|---|
| 5/16 | 250 | $5.00 | $5.00 |
| ⅜ | 250 | 7.50 | 7.50 |
| ½ | 100 | 10.00 | 10.00 |
| ⅝ | 50 | 13.00 | 13.00 |
| ¾ | 50 | 21.00 | 21.00 |
| 1 | 50 | 26.00 | 26.00 |
| 1¼ | 25-50 | 35.00 | 35.00 |
| 1½ | 25-50 | 45.00 | 45.00 |
| 2 | 25-50 | 52.00 | 52.00 |
| 2½ | 25-50 | | |

## CONDUIT, METALLIC FLEXIBLE—CONTINUED

| | ⅜" Single Strip Chicago | ⅜" Single Strip N. Y. | ⅜" Double Strip Chicago | ⅜" Double Strip N. Y. |
|---|---|---|---|---|
| Less than coil per 1000 ft., net | $75.00 | $75.00 | $78.75 | $82.50 |
| Cost to 1000 ft. per 1000 ft., net | 63.75 | 61.50 | 71.25 | 75.00 |

| | ½" Single Strip Chicago | ½" Single Strip N. Y. | ½" Double Strip Chicago | ½" Double Strip N. Y. |
|---|---|---|---|---|
| Less than coil per 1000 ft., net | $100.00 | $100.00 | $105.00 | $110.00 |
| Cost to 1000 ft. per 1000 ft., net | 85.00 | 85.00 | 95.00 | 100.00 |

## CONDUIT, NON-METALLIC FLEXIBLE

| Size, in. | List, per Foot Chicago | List, per Foot N. Y. | Size, in. | List, per Foot Chicago | List, per Foot N. Y. |
|---|---|---|---|---|---|
| 7/32 | $0.05½ | $0.05½ | 1 | $0.25 | $0.25 |
| ¼ | .06 | .06 | 1¼ | .33 | .33 |
| ⅜ | .09 | .09 | 1½ | .40 | .40 |
| ½ | .12 | .12 | 1¾ | .47 | .47 |
| ⅝ | .15 | .15 | 2 | .55 | .55 |
| ¾ | .18 | .18 | 2¼ | .65 | .65 |

| Per 1000 Ft. Net. | 7/32 In. Chicago | 7/32 In. N. Y. | ¼ In. Chicago | ¼ In. N. Y. |
|---|---|---|---|---|
| Less than $15.00 list | $36.67 | $55.00 | $40.00 | $60.00 |
| $15.00 to $60.00 list | 27.50 | 24.50 | 30.00 | 27.00 |
| $60.00 to $150.00 list | 24.75 | 21.50 | 27.00 | 23.50 |

## CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

(*Card No. 38*)

| Size, in. | Conduit, List per Foot Chicago | Conduit, List per Foot N. Y. |
|---|---|---|
| ¼ | $0.08½ | $0.08½ |
| ⅜ | .08½ | .08½ |
| ½ | .08½ | .08½ |
| ¾ | .11½ | .11½ |
| 1 | .17 | .17 |
| 1¼ | .23 | .23 |
| 1½ | .27½ | .27½ |
| 2 | .37 | .37 |
| 2½ | .58½ | .58½ |
| 3 | .76½ | .76½ |

| Size, in. | Couplings, List, Each Chicago | Couplings, List, Each N. Y. | Elbows, List, Each Chicago | Elbows, List, Each N. Y. |
|---|---|---|---|---|
| ¼ | $0.05 | $0.05 | $0.19 | $0.19 |
| ⅜ | .06 | .06 | .19 | .19 |
| ½ | .07 | .07 | .19 | .19 |
| ¾ | .10 | .10 | .25 | .25 |
| 1 | .13 | .13 | .37 | .37 |
| 1¼ | .17 | .17 | .45 | .45 |
| 1½ | .21 | .21 | .60 | .60 |
| 2 | .28 | .28 | 1.10 | 1.10 |
| 2½ | .40 | .40 | 1.80 | 1.80 |
| 3 | .60 | .60 | 4.80 | 4.80 |

| | Discount, ¼ In. to ½ In. Chicago | Discount, ¼ In. to ½ In. N. Y. | Discount, ¾ In to 3 In. Chicago | Discount, ¾ In to 3 In. N. Y. |
|---|---|---|---|---|
| Less than 2500 lb | 3.8% | 6% | 5.8% | 8% |
| 2500 to 5000 lb | 6.8% | 9% | 8.8% | 9% |

(For galvanized deduct six points from above discounts.)

## FLATIRONS

| | Chicago | N. Y. |
|---|---|---|
| List | $4.50 | $5.00 |
| Discount | 25% | 30% |

## FUSES, INCLOSED

| 250-Volt | Std. Pkg. | List Chicago | List N. Y. |
|---|---|---|---|
| 3-amp. to 30-amp. | 100 | $0.25 | $0.25 |
| 35-amp. to 60-amp. | 100 | .35 | .35 |
| 65-amp. to 100-amp. | 50 | .90 | .90 |
| 110-amp. to 200-amp. | 25 | 2.00 | 2.00 |
| 225-amp. to 400-amp. | 25 | 3.60 | 3.60 |
| 450-amp. to 600-amp. | 10 | 5.50 | 5.50 |
| **600-Volt** | | | |
| 3-amp. to 30-amp. | 100 | $0.40 | $0.40 |
| 35-amp. to 60-amp. | 100 | .60 | .60 |
| 65-amp. to 100-amp. | 50 | 1.50 | 1.50 |
| 110-amp. to 200-amp. | 25 | 2.50 | 2.50 |
| 225-amp. to 400-amp. | 25 | 5.50 | 5.50 |
| 450-amp. to 600-amp. | 10 | 8.00 | 8.00 |

### FUSES, INCLOSED—CONTINUED

| Discount | Chicago | N. Y. |
|---|---|---|
| Less than 1/5 std. pkg. | 28% | 28% |
| 1/5 to std. pkg. | 38% | 32% |

### FUSE PLUGS

*3-Amp. to 30-Amp.*

| Per 100 Net | Chicago | N. Y. |
|---|---|---|
| Less than 1/5 std. pkg | $6.25 | $5.00 |
| 1/5 to std. pkg. | 5.25 | 4.50 |

Standard package, 500. List, $0.07.

### LAMPS, MAZDA

*105 to 125 Volts*

| Regular, clear: | Std. Pkg. | List, Each—Chicago | List, Each—N. Y. |
|---|---|---|---|
| 10 to 40-watt—B | 100 | $0.27 | $0.27 |
| 60-watt—B | 100 | .36 | .36 |
| 100-watt—B | 24 | .65 | .65 |
| 75-watt—C | 50 | .65 | .65 |
| 100-watt—C | 24 | 1.00 | 1.00 |
| 200-watt—C | 24 | 2.00 | 2.00 |
| 300-watt—C | 24 | 3.00 | 3.00 |
| Round bulbs, 3½-in., frosted: | | | |
| 15-watt—G 25 | 50 | .50 | .50 |
| 25-watt—G 25 | 50 | .50 | .50 |
| 40-watt—G 25 | 50 | .50 | .50 |
| Round bulbs, 3¾-in., frosted: | | | |
| 60-watt—G 30 | 24 | .72 | .72 |
| Round bulbs, 4⅝-in., frosted: | | | |
| 100-watt—G 35 | 24 | 1.05 | 1.05 |

| | Discount—Chicago | Discount—N. Y. |
|---|---|---|
| Less than std. pkg. | Net | Net |
| Std. pkg | 10% | 10% |

### LAMP CORD

*Cotton-Covered, Type C, No. 18*

| | Per 1000 Ft. Net—Chicago | Per 1000 Ft. Net—N. Y. |
|---|---|---|
| Less than coil (250 ft.) | $37.52 | $35.17 |
| Coil to 1000 ft. | 28.14 | 26.73 |

### LAMP GUARDS, WIRE

| Per 100 Net | Chicago | N. Y. |
|---|---|---|
| Less than 50, Matthews 16-cp | $20.00 | $20.00 |
| Less than 1/5 std. pkg. Hubbell | 28.35 | 23.80 |
| Less than 36, 60-watt Loxon | 25.00 | 3.15 doz. |

### OUTLET BOXES

| Union Cat. No. | Black, List, per 100—Chicago | Black, List, per 100—N. Y. |
|---|---|---|
| 101 | $30.00 | $30.00 |
| 102 | 30.00 | 30.00 |
| 103 | 25.00 | 25.00 |
| 106 | 20.00 | 20.00 |

| Union Cat. No. | Galv., List, per 100—Chicago | Galv., List, per 100—N. Y. |
|---|---|---|
| 101 | $30.00 | $30.00 |
| 102 | 30.00 | 30.00 |
| 103 | 25.00 | 25.00 |
| 106 | 20.00 | 20.00 |

| Discount | Black—Chicago | Black—N. Y. | Galvanized—Chicago | Galvanized—N. Y. |
|---|---|---|---|---|
| Less than $10 00 list | 40% | 35% | 35% | 27% |
| $10.00 to $50.00 list | 50% | 42% | 45% | 37% |

### PIPE FITTINGS

*Condulets, V.V., Unilets and Similar*

| Discount | Chicago | N. Y. |
|---|---|---|
| Less than 1/5 std. pkg. | 10% | 10% |
| 1/5 to std. pkg. | 20% | 20% |
| Std. pkg. | 30% | 30% |

### PORCELAIN CLEATS—UNGLAZED

*2 and 3 Wire*

| | Per 1000 Net—Chicago | Per 1000 Net—N. Y. |
|---|---|---|
| Less than 1/5 std. pkg. | $14.00 | $15.80 |
| 1/5 to std. pkg. | 13.00 | 14.80 |

Standard package, 2200. List per 1000, $20.

### PORCELAIN KNOBS

| Per 1000 Net | 5½ N.C.—Solid Std. Pkg. 3500 Chicago | 5½ N.C.—Solid Std. Pkg. 3500 N. Y. | Nail-it—N.C. Std. Pkg. 4000 Chicago | Nail-it—N.C. Std. Pkg. 4000 N. Y. |
|---|---|---|---|---|
| Less than 1/5 std. pkg. | $10.50 | $24.30 | $28.00 | $21.50 |
| 1/5 to std. pkg. | 9.75 | 12.15 | 21.50 | 16.00 |

### SOCKETS AND RECEPTACLES

| | Std. Pk. | List—Chicago | List—N. Y. |
|---|---|---|---|
| ⅛-in. cap key socket | 500 | $0.33 | $0.33 |
| ⅛-in. cap keyless socket | 500 | .30 | .30 |
| ⅛-in. cap pull socket | 250 | .60 | .60 |

| Discount | Chicago | N. Y. |
|---|---|---|
| Less than 1/5 std. pkg. | List | List |
| 1/5 to std. pkg. | 15% | 15% |

### SWITCHES, KNIFE

*250-Volt, Front Connections, No Fuse*

| Perkins or Trumbull Type A: | List—Chicago | List—N. Y. |
|---|---|---|
| 30-amp. S. P. S. T. | $0.80 | $0.80 |
| 60-amp. S. P. S. T. | 1.20 | 1.20 |
| 100-amp. S. P. S. T. | 2.25 | 2.25 |
| 200-amp. S. P. S. T. | 3.48 | 3.48 |
| 300-amp. S. P. S. T. | 5.34 | 5.34 |
| 30-amp. D. P. S. T. | 1.20 | 1.20 |
| 60-amp. D. P. S. T. | 1.78 | 1.78 |
| 100-amp. D. P. S. T. | 3.38 | 3.38 |
| 200-amp. D. P. S. T. | 5.20 | 5.20 |
| 300-amp. D. P. S. T. | 8.00 | 8.00 |
| 30-amp. 3 P. S. T. | 1.80 | 1.80 |
| 60-amp. 3 P. S. T. | 2.68 | 2.68 |
| 100-amp. 3 P. S. T. | 5.08 | 5.08 |
| 200-amp. 3 P. S. T. | 7.80 | 7.80 |
| 300-amp. 3 P. S. T. | 12.00 | 12.00 |
| Perkins Type B or Trumbull Type C: | | |
| 30-amp. S. P. S. T. | 0.42 | 0.42 |
| 60-amp. S. P. S. T. | 0.74 | 0.74 |
| 100-amp. S. P. S. T. | 1.50 | 1.50 |
| 200-amp. S. P. S. T. | 2.70 | 2.70 |
| 30-amp. D. P. S. T. | 0.68 | 0.68 |
| 60-amp. D. P. S. T. | 1.22 | 1.22 |
| 100-amp. D. P. S. T. | 2.50 | 2.50 |
| 200-amp. D. P. S. T. | 4.50 | 4.50 |
| 30-amp. 3 P. S. T. | 1.02 | 1.02 |
| 60-amp. 3 P. S. T. | 1.84 | 1.84 |
| 100-amp. 3 P. S. T. | 3.76 | 3.76 |
| 200-amp. 3 P. S. T. | 6.76 | 6.76 |

DISCOUNT

| Type A, Perkins or Trumbull: | Chicago | N. Y. |
|---|---|---|
| Less than $10 list | Net | List |
| $10 to $25 list | 15% | 15% |
| $25 to $50 list | 18% | 18% |
| Type B, Perkins, or Type C, Trumbull: | | |
| Less than $10 list | 10% | 10% |
| $10 to $25 list | 20% | 20% |
| $25 to $50 list | 28% | 28% |

### SWITCHES, SNAP AND FLUSH

*5-Amp. and 10-Amp., 125-Volt Snap Switches*

| | Std. Pkg. | List—Chicago | List—N. Y. |
|---|---|---|---|
| 5-amp. single-pole | 250 | $0.28 | $0.28 |
| 5-amp. single-pole, ind. | 250 | .32 | .32 |
| 10-amp. single-pole | 100 | .48 | .48 |
| 10-amp. single-pole, ind. | 100 | .54 | .54 |
| 5-amp., three-point | 100 | .56 | .56 |
| 10-amp., three-point | 50 | .76 | .76 |
| 10-amp., 250-volt, D. P. | 100 | .66 | .66 |

*10-Amp., 250-Volt Push-Button Switches*

| | Std. Pkg. | List—Chicago | List—N. Y. |
|---|---|---|---|
| 10-amp. single-pole | 100 | $0.45 | $0.45 |
| 10-amp. three-way | 50 | .70 | .70 |
| 10-amp. double-pole | 50 | .70 | .70 |

| Discount | Chicago | N. Y. |
|---|---|---|
| Less than 1/5 std. pkg. | +20% | Net |
| 1/5 to std. pkg. | Net | 15% |
| Std. pkg. | 30% | 28% |

### SWITCH BOXES, SECTIONAL CONDUIT

| C. F. Mfg. Co. | List, Each—Chicago | List, Each—N. Y. |
|---|---|---|
| No. 155 | $0.34 | $0.34 |
| No. 160 | 0.60 | 0.60 |

| Discount | Black—Chicago | Black—N. Y. | Galvanized—Chicago | Galvanized—N. Y. |
|---|---|---|---|---|
| Less than $2.00 list | 25% | 40% | 20% | 30% |
| $2.00 to $10.00 list | 25% | 50% | 20% | 40% |
| $10.00 to $50.00 list | 25% | 60% | 20% | 52% |

### TOASTERS, UPRIGHT

| | Chicago | N. Y. |
|---|---|---|
| List | $4.50 | $5.00 |
| Discount | 25% | Net |

### WIRE, ANNUNCIATOR

| Per Lb. Net | Chicago | N. Y. |
|---|---|---|
| No. 18, less than full spools | $0.65 | $0.42½ |
| No. 18, full spools | 0.55 | 0.41¼ |

### WIRE, RUBBER-COVERED, N. C.

*Solid-Conductor, Single-Braid*

| No. | Price per 1000 Ft. Net—Less than 500 Ft. Chicago | Less than 500 Ft. N. Y. | 500 to 1000 Ft. Chicago | 500 to 1000 Ft. N. Y. | 1000 to 5000 Ft. Chicago | 1000 to 5000 Ft. N. Y. |
|---|---|---|---|---|---|---|
| 14 | $18.00 | $18.00 | $16.00 | $14.50 | $14.00 | $12.50 |
| 12 | 29.89 | 28.35 | 25.62 | 24.30 | 21.35 | 17.82 |
| 10 | 41.51 | 39.27 | 35.58 | 33.66 | 29.65 | 24.68 |
| 8 | 60.13 | 56.49 | 51.54 | 48.42 | 42.95 | 33.51 |
| — | 82.20 | 89.57 | 75.35 | 76.80 | 68.50 | 56.36 |

### WIRE, WEATHER-PROOF

*Solid-Conductor, Triple-Braid, Sizes 4/0 to 8, Inc.*

| | Per 100 Lb. Net—Chicago | Per 100 Lb. Net—N. Y. |
|---|---|---|
| Less than 25 lb. | $45.00 | $40.25 |
| 25 to 50 lb. | 44.00 | 39.25 |
| 50 to 100 lb. | 43.00 | 38.25 |

# NEW APPARATUS AND APPLIANCES

*A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field*

## Welding Operator's Shield

A shield for welding operators that is very light, being constructed of aluminum and wood fiber, and which is supported entirely on the head of the operator, has been developed. The operator can easily open and close the door containing the colored glasses, thus making it convenient for him to examine his work without removing the shield. When the door is opened there is still a glass, protecting the eyes from any flying particles. The construction of the shield prevents the possibility of glare or reflection from the side or rear. An apron of fireproof material protects the chest of the operator from the arc. The Favorite Manufacturing Company of Columbus, Ohio, makes these shields.

## Fuse Box

A combined disconnecting switch and fuse box for use on distribution lines operating at pressures up to 6600 volts, and carrying 1 amp. to 100 amp., has been developed by the Fisher-Chase Manufacturing Company of Columbus, Ohio. The switch is inclosed in a wooden box which has an arc-discharge relief hole of porcelain in the bottom. By means of a wooden pull-rod on one side of the box the switch can be operated without opening the door. The leverage on the switch-arm end of the pull rod is very short and permits quick closing and separation of contacts, thus minimizing the possibility of arcing without the use of springs. Melting and welding across the terminals is practically impossible because of the widely separated poles.

With the construction employed it is possible for a lineman, after inserting a new fuse, to close the door before closing the switch, thus avoiding the possibility of a fuse blow-out in his face, which might occur if the circuit was overloaded when the fuse was inserted. Delay in determining whether a fuse is blown is eliminated since the paper indicator which blows out of the arc-discharge hole when the fuse blows can be seen without climbing the pole. Furthermore, on three-phase installations where one fuse is broken mechanically or otherwise inspection may be made without interfering with the customer's installation, as the load may be supplied over the two intact circuits.

DISCONNECTING SWITCH AND FUSE BOX

## Automatic Feed-Water Regulator

An automatic feed-water regulator which controls the flow of water into the boiler by the height of the water line is shown in Fig. 1. It is manufactured by the Kitts Manufacturing Company of Oswego, N. Y. The float which is used in the feeder column and the alarm column will not collapse or give trouble from leakage, it is claimed. It is counterbalanced by a brass weight. When the water reaches a certain level the buoyancy of the water lifts the float, which in turn opens the pilot valve, admitting pressure on the diaphragm feed valve and thereby closing it. When the water line begins to lower, the float lowers, closing the pilot valve and opening the exhaust port, thereby relieving the pressure from the diaphragm feed valve and allowing it to open. By this operation the water is kept at or near the second gage cock, which is in the proper place.

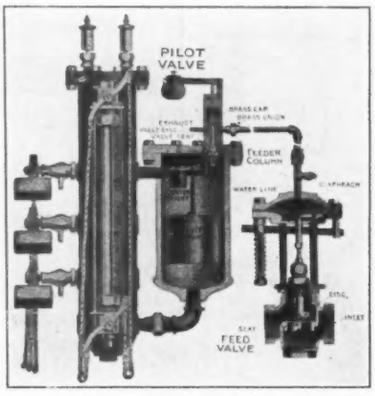



FIG. 1—AUTOMATIC FEED-WATER REGULATOR

The pilot valve may be removed for repairs at any time, as the automatic check under the cover prevents the escape of steam. The seats and disks of the pilot valve and feed valve can also be renewed when necessary. The accompanying meter chart shows how nearly a continuous flow of water is obtained by using this automatic feed-water regulator.

In order to secure good results from an automatic feed-water regulator it is very essential that the pumps be properly governed. A high excess pressure part of the time and a low excess pressure at other times should be avoided. Excess pump governors are usually built like scales of the differential type. The slightest variation in the pumping pressure is almost instantly compensated for so the pressure on the feed line to the boilers remains practically the same, no matter what the load is. Should the pressure on the boiler change very suddenly for any reason, the excess pumping pressure will automatically change accordingly.

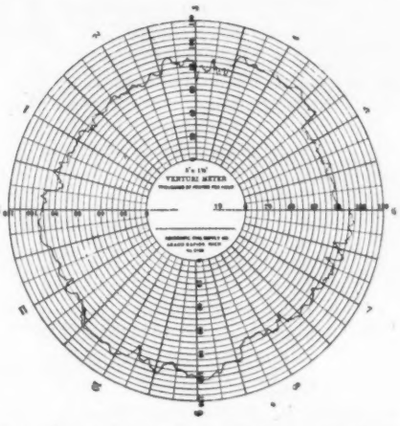


FIG. 2—CONTINUOUS FLOW OF WATER OBTAINED BY USE OF REGULATOR

## Headstock Motor for Woodworking Lathes

The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., is now marketing a line of headstock motor equipments for small woodworking lathes. The motors take the place of the cone pulleys and belts required on belt-driven woodworking lathes. The face plates are mounted directly on the motor shaft. Different speeds are obtained by adjusting the speed of the motor by means of a controller mounted in the leg of the lathe. The controller also permits dynamic braking. By this method of drive the quality of the work may be improved and the production may be greatly increased, as the operator is enabled to use exactly the right speed for the particular piece of work in hand.

Each equipment consists of a motor and a controller especially designed for this service. For alternating-current circuits a special four-speed ball-bear-

ing motor is furnished that can be mounted on the top of the lathe. The design of the motor frame permits removal of either end bracket and excludes all dust and foreign substances. The feet are cast integral with the brackets, giving maximum rigidity to the motor. The ball bearings take end thrust in either direction.

For direct-current circuits an adjustable-speed, commutating-pole, shunt-wound motor is furnished, giving speeds by field control over a range of from 600 to 3000 r.p.m. It is mounted in the same manner as the alternating-current motor and resembles it in general construction.

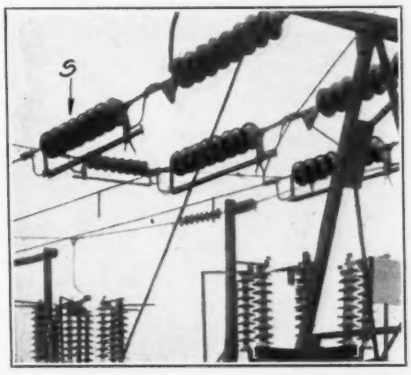
In starting the motor the line switch must be turned to "on," but a simple mechanical device makes it also necessary to have the speed adjustment handle in the first or low-speed position. Protection against low voltages and overloads is afforded by relays, which open the line circuit and stop the motor.

## Resistance Material

A plastic molding compound made from the anhydrous resin which results when dry phenol reacts with dry hexamethylenetetramine has been developed by the Redmanol Chemical Products Company of Chicago. It is said that this material has a permanent color and surface brilliance which are not impaired by age. It contains no ingredients which affect brass inserts or other metal parts harmfully. The molded products made by this company have high tensile strength, high electrical resistance and are unaffected by solvents, oils, cleaners, heat or moisture, the manufacturer declares. The compound is furnished in rods, tubes, sheets, granular form, plastic form, impregnating liquids, laminated plates and transparent blocks.

## Disconnecting Switches

A convenient type of high-voltage disconnecting or sectionalizing switch is the suspension form. An unusual installation on the roof of a power house supplying a 110,000-volt system is shown herewith. The suspension switch




HIGH-VOLTAGE DISCONNECTING SWITCH

consists of eight disk insulators bridged by a horizontal truss blade provided with contact guides and locks to prevent the switch falling open accidentally. The method of installing the switch is indicated at *S*, the same scheme being employed when switches are to be installed in the main transmission lines. This particular form of switch, which has a wide application on high-voltage lines, is manufactured by the Delta-Star Electric Company of Chicago.

## Shop-Lighting Fixtures

Several types of fixtures for illuminating sewing machines have been developed by E. I. Van Doren of Troy, N. Y. These fixtures can also be used for all classes of individual lighting, as for machine-shop and bench practice. The shade, which is supported from the arm of the fixture, not only stiffens the socket but also projects the light directly upon the work, shading the light from the operator's eye. One type is made for single-stand sewing-machine illumination and is equipped to allow conduit to enter at the bottom of the fixture; another is for conduit over the table serving two machines, and a third type is for two machines with attachment plugs under the table. Fixtures are made for lathe and bench work in machine shops.

## Lamp for Rotogravure Printing

For use in connection with the making of rotogravure prints the Cooper Hewitt Electric Company of Hoboken,

MERCURY-VAPOR LAMP OUTFIT FOR PRINTING

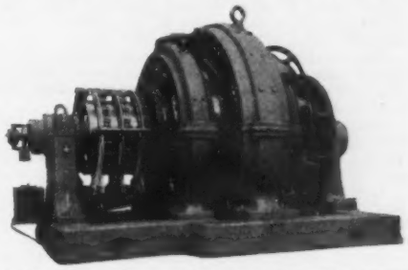
N. J., is marketing a special lighting outfit, one being shown herewith. It consists of six 67-in. (170-cm.), 7-amp. mercury-vapor tubes mounted in a stand, the auxiliaries with shifters being mounted at the end of the stand beneath the blower. The outfit is generally used with a printing frame on each side.

## One-Piece Socket

A one-piece socket which may be quickly wired has been placed on the market by J. I. Paulding of New Bedford, Mass. The sockets are made with standard interiors, enabling the wiremen to connect them quickly. An all-porcelain shell slides over the interior and is locked in place by the key shaft. By removing the key a keyless socket is obtained, so that the device combines in one a key, a keyless and a lock socket.

## Synchronous Booster Rotary Converter

Synchronous booster rotary converters manufactured by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., consist of a shunt-wound rotary converter in combination with an alternating-current generator mounted on the same shaft with the



MACHINE WHICH GIVES RELATIVELY WIDE, AUTOMATIC OR NON-AUTOMATIC VARIATION IN DIRECT-CURRENT VOLTAGE

rotary converter and having the same number of poles. By varying the field excitation of this alternating-current generator the alternating-current voltage impressed on the rotary converter proper can be increased or decreased as desired. The direct-current voltage delivered by the converter is thereby varied accordingly.

Standard synchronous booster rotary converters are wound for 270 volts direct current, with a range of 240 to 300 volts, and for the desirable and usual converter ratings of 500 kw. and above, both for 25 and 60 cycles. As previously stated, the direct-current voltage range can be made of any desired value by properly proportioning the booster generator capacity. For extreme voltage ranges special booster converters are required. It is rarely practicable to obtain more than 15 per cent buck or boost. The standard variation is a total range of 20 per cent, that is, 10 per cent below and 10 per cent above the average voltage for which the converter is designed. This range is obtained by a boosting generator with a capacity of 10 per cent of that of the converter.

Compared with the transformer or induction regulator method of voltage regulation the booster rotary converter method has the following advantages, it is claimed: There is only one unit, which requires minimum floor space and cable connections. This simplifies installations as there are no connections to make between several pieces of apparatus. The booster converter has rugged characteristics. With induction regulators dangerous forces may be developed between the stator and the rotor, if the converter is connected to the alternating-current line while out of step.

Compared with the so-called regulating-pole or split-pole converter method of regulation, the synchronous booster rotary converter possesses higher efficiency, particularly at the lower voltages, and has better commutation, particularly at the maximum voltage and at the maximum load.

## Trade Notes

FRANK CONNELL, secretary and treasurer of the Stinna Engine Company, Erie, Pa., died on April 28.

THE McINTOSH & SEYMOUR CORPORATION, Auburn, N. Y., has changed its New York office from 50 Church Street to 149 Broadway.

W. J. McDOWELL has resigned from the sales force of the Walker Vehicle Company to rejoin the sales force of the General Motors Truck Company at Chicago.

VAUGHN & MEYER, consulting engineers, have moved their offices from the Majestic Building, Milwaukee, to the Security Building in the same city.

WORLD'S SALESMANSHIP CONGRESS.—The second annual session of the World's Salesmanship Congress will be held at Detroit from June 10 to 14.

GEORGE W. NEFF has taken charge of the Eastern management of the John H. McGowen Company of Cincinnati, Ohio, with offices at 50 Church Street.

THE NATIONAL FIBRE & INSULATION COMPANY, York Lynne, Del., has awarded a contract for the erection of a one-story addition to its plant.

THE GENERAL ELECTRIC COMPANY is moving its New York office from 30 Church Street to the Equitable Building, 120 Broadway, where it will occupy the entire twentieth floor.

THE GENERAL ELECTRIC COMPANY has had plans prepared for a new brick and reinforced-concrete plant to be erected on Lillie Street, Newark, N. J. The structure will be four-story and basement.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., has announced the removal of its sales and publicity promotion department to the administration suite at 130-132 South Sangamon Street.

THE ELECTRICAL EQUIPMENT ASSOCIATION, 216 Judge Building, Salt Lake City, Utah, has been formed by Arthur Purdon. The company will represent the Electrical Engineers' Equipment Company of Chicago.

THE FEDERAL ELECTRIC COMPANY of Pittsburgh, Pa., manufacturer of switch boxes, outlet boxes, cabinets, push buttons and receptacle plates, has just appointed S. Robert Schwartz & Brother, at 729-31 Broadway, New York City, as its Eastern agents.

T. E. WEBSTER, it is announced, has become vice-president of the R. H. Beaumont Company, builder of conveying and hoisting systems, of Philadelphia, and has identified himself with the sales department. Mr. Webster was associated with the Link Belt Company for twenty-five years and for the last twelve years was manager of its Pittsburgh office.

FRANK M. HAWKINS, since 1897 managing representative of the New York territory of the Crouse-Hinds Company, has retired from detail sales work and engaged in the broader activity of looking into business possibilities abroad. For a while Mr. Hawkins will investigate the Cuban and other southern foreign markets. After the war is over he contemplates a tour of Europe to study conditions preliminary to the development of a market abroad for the Crouse-Hinds products.

THE S K F BALL BEARING COMPANY, Hartford, Conn., and the Hess-Bright Manufacturing Company of Philadelphia have joined interests, and the affairs of the two companies will be administered by a recently formed New York Corporation, the S K F Administrative Company, 1 Wall Street. B. G. Prytz has been elected president of the administrative company. Simultaneously, Budd D. Gray of the Hess-Bright Company has resigned as president of the Philadelphia company and will become technical adviser to the new corporation. Mr. Prytz was elected to succeed Mr. Gray as president of the Hess-Bright Company. The S K F Administrative Company is extending the manufacturing facilities of both the Philadelphia and Hartford plants, and the demand for the company's products continues to be so far in excess of the present supply that it has been considered advisable to make additions immediately both to the S K F and the Hess-Bright factories. Closer co-operation between the two companies was greatly facilitated by the action of the American Hess-Bright stockholders in buying out the German minority interest in the Hess-Bright Company shortly before the break with Germany, whereby all the stock came into American hands.

THE REMMERT ELECTRIC COMPANY of St. Louis, which maintains branches in Chicago, Kansas City and Springfield, has closed a lease with the Plankinton Arcade Company, Milwaukee, for a main rotunda store space for a period of five years.

THE DUQUESNE ELECTRIC & MANUFACTURING COMPANY is the new name recently adopted by the Service Supply & Equipment Company, Bessemer Building, Pittsburgh, Pa., as specialists on new and second-hand electrical equipment and electrical repair work. The Duquesne Electric & Manufacturing Company has opened a large repair shop at East Liberty, Pa., with sales offices in the Bessemer Building, Pittsburgh, under the same management.

## New Incorporations

THE ADAIRVILLE (OHIO) LIGHTING COMPANY has been incorporated with a capital stock of $12,000 by R. B. E. Brian, J. E. Russell and R. W. Russell.

THE C. L. WALTON LIGHTING COMPANY of Scales Mound, Ill., has been incorporated with a capital stock of $2,500 by C. S. Walton, Richard Rogers and T. Walton.

THE PARAMOUNT ELECTRIC COMPANY of Cleveland, Ohio, has been incorporated with a capital stock of $5,000 by Benjamin Stern, A. E. Fromholz, Herman L. Castle and others.

THE SNOHOMISH POWER COMPANY of Seattle, Wash., has been incorporated with a capital stock of $1,000,000 by George H. Tilden, William H. Wynn, Jr., and H. W. Bunker.

THE BOWLING GREEN (VA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 to operate a light and power plant. L. E. Martin is president, and B. F. Borkey, secretary, both of Bowling Green.

THE ODESSA (TEX.) LIGHT & POWER COMPANY has been chartered by R. M. Henderson, W. F. Bates and W. H. Rhoades. The company is capitalized at $4,000 and proposes to construct and operate an electric-light and power plant.

THE STERLING ELECTRICAL CORPORATION of Cleveland, Ohio, has been incorporated with a capital stock of $250,000 by Roy M. Hall, W. H. Fahrenbach, C. E. Edson, P. Hess and Antonio Longoria.

THE PERFECT FUSE COMPANY of Buffalo, N. Y., has been chartered with a capital stock of $10,000 to do a general and electrical contracting business. The incorporators are W. N. Pierce, J. Franklin and B. C. Candee of Buffalo, N. Y.

THE COMMERCIAL ELECTROLYTIC CORPORATION OF CALIFORNIA of Los Angeles, Cal., has been chartered with a capital stock of $100,000. The directors are: F. E. Stevens, John McWilliams, Jr., R. T. Laughlin, J. R. Mason and E. F. Wehrle.

THE MUNICIPAL POWER & LIGHT COMPANY of Shawnee, Okla., has been incorporated with a capital stock of $3,000 by Sinclair Mainland of Oshkosh, Wis.; W. S. Arnold of Chicago, Ill., and Edward Howe of Shawnee.

THE HUBBEL ELECTRIC COMPANY of Rockford, Mich., has been chartered by H. L. Hubbel, J. R. Gale and J. J. Waterson. The company is capitalized at $15,000 and proposes to manufacture and deal in electrical apparatus and equipment.

THE HOLLAND (MICH.) LIGHT & SPECIALTY COMPANY has been incorporated by A. H. Landmehr, J. P. Kolla, O. P. Neptrum and others. The company is capitalized at $35,000 and proposes to manufacture and sell lighting systems.

THE MULLIKEN (MICH.) ELECTRIC LIGHTING COMPANY has been incorporated by James H. Henskey, C. A. Trimble, W. J. Ramsey and others. The company is capitalized at $3,000 and proposes to supply electricity for lamps and motors in Mulliken.

THE PORTABLE ELECTRIC SEARCHLIGHT COMPANY of Boston, Mass., has been chartered with a capital stock of $40,000. The officers are: N. B. Kneass Brooks of Wellesley, Frank M. Lawrence of Cambridge, treasurer, and Damon E. Hall of Cambridge, clerk.

THE AUTOMATIC ELECTRIC CROSSING & GATE COMPANY of Philadelphia, Pa., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $500,000 to manufacture electrical safety devices for railways. The incorporators are: F. R. Hansell, George H. B. Martin and S. C. Seymour, all of Philadelphia, Pa.

THE ACME ELECTRIC WORKS of Norfolk, Va., has been incorporated with a capital stock of $50,000 to deal in electrical supplies. W. E. Thomas is president and J. H. Hare secretary, both of Norfolk, Va.

THE ADAMS & GENTER SALES CORPORATION of Salt Lake City, Utah, has been incorporated with a capital stock of $5,000 to deal in electrical appliances. The officers are: John N. Adams of Logan, president; A. L. Genter of Salt Lake City, Utah, vice-president; Paul H. Genter of Logan, secretary.

THE COLUMBIA X-RAY & ELECTRIC CORPORATION of New York, N. Y., has been chartered by C. E. Kramer, R. and B. L. Spitzer, 254 West Seventy-second Street, New York, N. Y. The company is capitalized at $20,000 and proposes to manufacture X-ray machines and electric therapeutic machinery.

THE WATEREE ELECTRIC COMPANY, 75 Montgomery Street, Jersey City, N. J., has been incorporated by Walter C. Parker, David C. Phillips and Alexander M. Sands, Jr. The company is capitalized at $7,500,000 and proposes to acquire water rights, operate electric-lighting and power plants and engage in manufacturing and agricultural pursuits.

## Trade Publications

SOCKETS.—Pass & Seymour of Solvay, N. Y., are distributing a leaflet descriptive of their porcelain angle caps and sockets.

RANGES.—The Estate Stove Company of Hamilton, Ohio, has prepared catalog No. 10, descriptive of its electric ranges.

SURFACER.—The Berg Rotary Concrete Surfacer is illustrated and described in a bulletin recently issued by the Elevator Supplies Company, Inc., of New York City.

SOLENOID BRAKES.—Automatic solenoid brakes and solenoids are illustrated and described in bulletin No. 48,900, now being distributed by the General Electric Company of Schenectady, N. Y.

MOTOR-GENERATOR SETS.—Small battery-charging outfits for charging ignition and lighting batteries are described and illustrated in a leaflet now being distributed by the General Electric Company of Schenectady, N. Y.

GRIDS.—Bulletin No. 58,329A, descriptive of frame parts and CR 9042 grids for type IG resistors, is now being mailed by the General Electric Company of Schenectady, N. Y. This company has also prepared bulletin No. 44,406A, descriptive of its ventilated commutating-pole railway motor.

VALVES AND FITTINGS.—The Edward Valve & Manufacturing Company of Chicago has prepared its 1917 catalog, No. 6, covering a full line of cast-steel, forged-steel and bronze-bodied globe valves and blow-off valves. Atmospheric relief valves, unions, fittings, etc., are also mentioned.

INSULATORS.—The Electrose Manufacturing Company of Brooklyn, N. Y., has prepared a bulletin descriptive of its insulators. This bulletin includes extracts from articles which have appeared from time to time in various trade papers in which Electrose insulators were mentioned.

OIL ENGINES.—High-compression oil engines are described and illustrated in a bulletin now being distributed by McEwen Brothers of Wellsville, N. Y. This oil engine is a horizontal, four-stroke-cycle type high-compression engine, operating on the Diesel principle and adapted to burn any kind of heavy crude oil or residue.

INSULATORS.—A report rendered to the Electrose Manufacturing Company on a high-voltage test of Electrose insulated connectors for W. S. Barstow & Company is being distributed by the Electrose Manufacturing Company of Brooklyn, N. Y. These tests were made by the Electrical Testing Laboratories.

GEAR SHIFT.—"What Motor Car Distributors Are Doing" is the title of a large mailing folder distributed by the Cutler-Hammer Manufacturing Company of Milwaukee, maker of the "C-H Magnetic" gear shift. What this device is doing for the Premier is told by means of excerpts from letters, telegrams, newspaper and magazine articles, etc. Reasons for the adoption of the C-H gear shift as regular equipment are also cited. Among the photographs reproduced is one showing Miss Rochester in the Premier which she drove up the court house steps at San Antonio, Tex. Another shows C. H. Davis of Denver with one arm tied to his side, in which condition he drove through the congested section of Denver for six hours, starting and stopping at crossings and to take on passengers, manipulating the "C-H Magnetic" gear shift buttons and steering with the right hand.

## New England States

BIDDEFORD, ME.—The York County Power Company has petitioned the Public Utilities Commission for authority to issue $100,000 in bonds, of which $48,000 is to be used for extensions contemplated and the remainder to reimburse the company for improvements recently completed.

PORTLAND, ME.—The Thomas Laughlin Company has contracted with the Cumberland County Power & Light Company for electrical energy to operate its plant. Steam power is now used.

YARMOUTH, ME.—Arrangements have been made whereby the Yarmouth Lighting Company will secure energy from the Cumberland County Power & Light Company of Portland. Work will begin at once by the Cumberland company on the erection of electric transmission lines across the county to connect with the lines of the Yarmouth company.

PENNACOOK, N. H.—The Public Service Commission has granted the Concord (N. H.) Electric Company authority to purchase the property of the Pennacook Electric Light Company for $60,000.

RUTLAND, VT.—Work has begun on the erection of a new 44,000-volt electric transmission line for the Rutland Railway Light & Power Company between the Mendon power station and the substations in Rutland, West Rutland and Castleton, to be completed about July 1. This will necessitate doubling the output of the Castleton substation and an addition to the generating equipment at the plant of the Pittsford Power Company. The new equipment at the Castle substation will consist of a 500-kw. rotary converter; a 750-hp. water wheel will be installed at the Pittsford Power Company's plant.

BOSTON, MASS.—Bids will be received by the schoolhouse commissioners of the city of Boston until May 22 for furnishing electric motors in the Boston Trade School, Parker and Archibald Streets, Boston, Mass. Proposal blanks may be obtained at the office of the commissioners, Room 1009, City Hall Annex.

BROCKTON, MASS.—The City Council is considering a proposal submitted by the Edison Electric Illuminating Company of Brockton for lighting the streets of the city, which provides for the installation of ornamental lamps in the business district, including Center Street, at no additional expense.

FALL RIVER, MASS.—The Fall River Electric Light Company has petitioned the Massachusetts Gas and Electric Light Commission for permission to erect electric transmission lines over the Taunton River at a point 1800 ft. north of its Fall River plant, just south of the Slade's Ferry Bridge. The proposed line will extend through Somerset, Swansea and Seekonk to the Rhode Island line. The commission recently refused the company permission to erect a line across the river at another location.

SOUTHBRIDGE, MASS.—The Stephen Richard Company, cutlery manufacturer, is contemplating extensions to its plant and power equipment.

SPRINGFIELD, MASS.—The Turners Falls (Mass.) Power & Electric Company has petitioned the Waterways Commission for authority to suspend cable wires over the Connecticut River from the Agawam side of the city.

WATERTOWN, MASS.—Bids will be received at the Watertown Arsenal, Watertown, Mass., until May 23, for furnishing miscellaneous supplies, including dry cells, etc., during the year ending June 30, 1918. Further information may be obtained on application to the commanding officer, Watertown Arsenal.

WATERTOWN, MASS.—Bids will be received at the Watertown Arsenal, Watertown, until May 23, for construction of an erecting shop, tunnel and coal-conveying apparatus and alterations and additions to the smith shop, power house and coal pocket, including plumbing and heating and railroad track. Further information may be obtained upon application to the commanding officer.

WESTFIELD, MASS.—The Turners Falls (Mass.) Power & Electric Company has applied to the Selectmen for permission to erect an electric transmission line from the Easthampton town line across Hampton Plains to the power station of the local division of the Springfield Street Railway Company, and thence along the Westfield River bank to the town of Agawam.

WOONSOCKET, R. I.—The Manufacturers' Power Company, which furnishes power and steam to the Nyanza and Samoset Mills, has purchased land at Second Avenue and River Street, for the purpose of building a coal pocket for its power plant on Singleton Street.

# *Construction*

**News of Projects, Plans, Bids and Contracts. Notes on Work Under Way**

NEW HAVEN, CONN.—A petition has been presented to the municipal committee on street lighting by the residents of Grand Avenue asking that ornamental lamps be installed on Grand Avenue from State Street and Railroad Avenue. The residents of Orange Street, from Chapel to Elm, have petitioned for a better lighting system on that thoroughfare.

## Middle Atlantic States

ALBANY, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 6 for remodeling two hydraulic mail lifts, etc., in the United States custom house and post office, Albany, N. Y. For details see proposal columns.

BINGHAMTON, N. Y.—The installation of the first two generator units for the new power house of the Binghamton Light, Heat & Power Company is nearly completed, and it is expected that within the next three weeks the 3500-kw. unit with two boilers and necessary auxiliaries will be ready to place in operation. Preparations are being made to begin work on the excavations for foundation for the third unit.

BROOKLYN, N. Y.—The Public Service Commission has approved an award of the Brooklyn Rapid Transit Company to Angelo Pasquini of New York City for the construction of the new Ridgewood substation to be used in connection with furnishing energy to operate the Fourteenth Street-Eastern Parkway and other new rapid transit lines in Brooklyn and Queens at $59,900. The building will be located on Gates Avenue, near Wyckoff Avenue, Brooklyn.

BUFFALO, N. Y.—The Buffalo General Electric Company, the New York Telephone Company, the Federal Telephone Company and the International Railway Company will be asked to place their wires on Virginia Street underground before the work of paving the street is undertaken.

CORNING, N. Y.—The bill to incorporate the Lamoka Electric Water Corporation of Corning and giving it power to develop the water power of Mud Creek has been passed by the Legislature. The company, it is reported, proposes to construct a dam near Savona and a canal and pipe line from Wayne to Lake Keuka, on the west shore of which a power house is to be erected between Grove Springs and Keuka.

GOVERNOR'S ISLAND, N. Y.—Bids will be received at the office of the quartermaster, Eastern Department, Governor's Island, N. Y., until May 25, for construction, including plumbing, heating and electric wiring, of a brick six-set officers' quarters at Governor's Island.

HORNELL, N. Y.—Preparations are being made for the installation of an ornamental street-lighting system. The Hornell Electric Company will bear the cost of laying the wires underground and the city will pay for the ornamental standards. The system throughout the city will be changed and arc lamps discarded.

ITHACA, N. Y.—Work has begun on the erection of the electric transmission line of the Cayuga Power Corporation from Portland Point to Peruton, thence to Groton, where the company has a contract to supply energy to the plant of the Corona Typewriter Company. As soon as material can be secured the transmission line will be extended to Freeville and to Dryden to furnish electrical service to those towns. The Cayuga corporation is negotiating with the village of Groton for the purchase of the municipal plant.

NEW YORK, N. Y.—Bids will be received by the Interborough Rapid Transit Company at the office of the chief engineer, 165 Broadway, New York City, until May 24, for completion of the passenger station electric-lighting and electric heating systems for portions of the Seventh Avenue line, routes 4 and 38; Pelham Bay Park branch of the Lexington Avenue line, route 5, section 15, and routes 19 and 22, sections 1 and 1-A, Lexington Avenue line, route 5. Drawings, proposal blanks, etc., may be obtained at the above office. George H. Pegram is chief engineer.

WATERTOWN, N. Y.—The Black River Traction Company contemplates an extension of its traction system to the Maxim munition plant in Water Street.

WOODBRIDGE, N. Y.—The Murray Electric Light & Power Company of Monticello is contemplating extending its electrical service to Woodbridge.

YONKERS, N. Y.—The City Council is considering the installation of 400 ornamental lamp standards, equipped with five-lamp clusters.

CALDWELL, N. J.—Bids will be received by the committee of public buildings of the Board of Freeholders of the county of Essex, Essex County Court House, Newark, until May 23 for additions and alterations in the power plant at the Essex County Penitentiary, Caldwell, N. J., as follows: (1) For boilers, stack and breeching; (2) engine, generator and switchboard. Plans and specifications may be seen at the office of Runyon & Carey, consulting engineers, 845 Broad Street, Newark, N. J.

HOBOKEN, N. J.—Bids will be received by the Board of Education of Hoboken until May 29 for construction of a new public school house to be erected at Adams and Fifth Streets, including electrical work, heating and ventilating. John J. Fagan, 95 River Street, Hoboken, is architect.

HOPEWELL, N. J.—The Borough Council has authorized the installation of a gas engine equipment to replace the oil engine now in use.

JERSEY CITY, N. J.—The City Commission is considering an application of the Great Atlantic & Pacific Tea Company for permission to build a conduit line for electric wires from its building on First Street to the plant of Edward V. Hartford, Inc., on Morgan Street.

LAKEWOOD, N. J.—Plans are being considered by the Lakewood & Seacoast Railway Company for the construction of its proposed extension from Lakewood to Point Pleasant.

LAMBERTVILLE, N. J.—The Board of Public Utility Commissioners has granted the Lambertville Public Service Company permission to issue securities for $430,000, the proceeds to be used for extensions and improvements.

NEWARK, N. J.—Bids will be received at the office of the board of education of Newark until May 21 for construction and completion of addition to the Madison school house, including general construction, plumbing, heating and ventilating, electrical work, lighting fixtures and vacuum cleaning system. Blank proposals and further information may be obtained at the construction department of the board, fourth floor, City Hall. R. D. Argue is secretary.

PERTH AMBOY, N. J.—A bond issue of $50,000 has been approved by the Board of Aldermen for the completion of the commercial system of the municipal electric-light plant. Arrangements will be made to furnish commercial service in the business and other districts of the city.

ALBION, PA.—The Public Service Commission has granted the United Lighting Company permission to issue $110,000 in bonds, the proceeds to be used for extensions and improvements.

BETHEL, PA.—The Blue Mountain Electric Company of Bethel is extending its electric transmission lines to Freystown.

COATESVILLE, PA.—The City Council has awarded the Chester Valley Electric Company a contract for furnishing energy to operate the municipal water-works pumping station.

EASTON, PA.—The Pennsylvania Utilities Company of Easton has closed a 10-year contract with the Warren Manufacturing Company to furnish energy to four of the paper mills of the company at Milford, Warren, Hughesville and Riegelsville, N. J., which will require about 3500 hp. in motors. To serve this consumer a double circuit 33,000-volt transmission line will be erected from Easton.

GREENVILLE, PA.—The Public Service Commission has granted the Mercer County Light, Heat & Power Company permission to issue $300,000 in bonds, the proceeds to be used for payment of the new plant recently completed in Greenville, also for the one at Kinsman, and also for other extensions contemplated.

KINGSTON, PA.—The Public Service Commission has authorized the Luzerne County Gas & Electric Company to issue $270,000 in bonds, the proceeds to be used for extensions and improvements.

PHILADELPHIA, PA.—The Philadelphia Drying Machine Company is planning to erect a power plant, about 35 ft. by 40 ft., one story high, at its proposed new factory on Westmoreland Street. Contract for building has been awarded.

SCRANTON, PA.—The Scranton Electric Company has been granted permission by the Public Service Commission to issue

$183,000 in bonds for extensions to its system.

SKIPPACK, PA.—Arrangements have been made by the borough committee for the installation of a new street-lighting system.

STEELTON, PA.—The Public Service Commission has approved the contract between the Harrisburg (Pa.) Light & Power Company and the borough of Steelton for street lighting. Under the terms of the contract the company will replace the arc lamps now in use with incandescent lamps.

TOPTON, PA.—Application for charters for three new electric companies for Topton, Mertztown and Bowers has been made by S. R. Rothermel of Reading, V. S. Martin of Topton, and W. J. Martion of Reading.

DUNDALK, MD.—The Dundalk Company has been incorporated with a capital stock of $5,100,000 to build an industrial city, mainly for the employees of the Bethlehem Steel Company at Sparrows Point. The plans provide for land developments, constructing sewer system, laying the water mains, installing electric-lighting system, building several thousand dwellings, etc. Edward H. Bouton, president of the Roland Park (Md.) Company, Frederick W. Wood of Bethlehem Steel Company of Sparrows Point, Henry R. Walker of South Bethlehem, Pa., and others are interested in the project.

BARBOURSVILLE, W. VA.—The Barboursville Water & Light Company, recently incorporated, has acquired the municipal electric-light plant. The company would like to receive prices on insulated wire. A. E. May, H. E. Love and W. G. Shipe are among the incorporators.

WILLIAMSON, W. VA.—The Wigarb Mining Company would like to receive prices on coal-mining machinery and electrical equipment. C. M. Gateso of Williamson is manager.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 28 to furnish and install one 80-ton bridge crane, one or more 10-ton bridge cranes, one 5-ton bridge crane, four 5-ton wall cranes, and five 2-ton electric hoists and hand-power travel bridge cranes in the new foundry at the navy yard, Norfolk, Va. Drawings and specification (No. 2388) can be obtained on application to the above bureau or to the commandant of the navy yard named.

NORFOLK, VA.—W. T. Gregory, 501 Law Building, Norfolk, it is reported, would like to receive prices on two electric elevators for store building.

RICHMOND, VA.—The Administrative Board has instructed John E. Butler, building inspector, to advertise for bids for building an addition to the municipal electric plant under plans prepared by Carneal & Johnston. The cost of the improvements is estimated at about $25,000. Bids will be received until May 25.

WASHINGTON, D. C.—The Southern Railway Company has authorized the erection of two copper telephone circuits between Spencer and Atlanta, a distance of 314 miles. The work will be done under the supervision of the superintendent of telegraph at Charlotte, N. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Various, Schedule 1116—miscellaneous cotton insulating tape, miscellaneous rubber insulating tape; Schedule 1098—72,450 batteries, suitable for flashlights, 18,800 flashlights without batteries; Schedule 1115—miscellaneous acid etched globes, miscellaneous prismatic reflectors: Schedule 1111—miscellaneous turbo-generating sets; Schedule 1114—miscellaneous weatherproof sockets. Las Animas, Col., Schedule 1103—one electrically operated dishwashing machine, one electrically operated potato peeler. Philadelphia, Pa., Schedule 1108—one 21-in. motor-driven upright drill, one double, 12-in., motor-driven grinder. Application for proposal blanks should designate the schedule desired by number.

## North Central States

HOWELL, MICH.—The City Council has decided to install ornamental lamps on all paved streets in the city, for which bids will soon be asked.

MONROE, MICH.—The City Commission has granted the Detroit (Mich) Edison Company a franchise to construct and operate an electric-lighting system in Monroe. Under the terms of the franchise the company is to purchase the municipal electric-light plant and furnish electrical service here.

MULLIKEN, MICH.—The Mulliken Electric Light Company, recently incorporated, is contemplating supplying electrical service in Mulliken. The company is capitalized at $3,000.

PORT HURON, MICH.—The Port Huron Gas & Electric Company has submitted a proposal to the City Commission for lighting the streets of the city for a period of either five or seven years. The company proposes to install new lamps to replace those now in use.

CANTON, OHIO.—The installation of an electric-lighting system on Woodland Avenue has been authorized by the City Council, and contracts for it will soon be awarded.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until May 29, for fiber conduit. Bids will also be received at the same time and place for a locomotive crane. Proposals will also be received at the same time for service switches for the division of light and heat. Specifications may be obtained upon application to the office of division of light and heat, room 204, City Hall.

COLUMBIANA, OHIO.—The Ohio Gas & Electric Company of Lisbon has presented a proposal to the City Council offering to purchase the local municipal electric plant and to supply electricity for all purposes.

DAYTON, OHIO.—Right of way is being secured by the Dayton Power & Light Company for the erection of a tower transmission line from Gunnersville to Xenia, a distance of about 15 miles.

EAST PALESTINE, OHIO.—The City Council is considering a proposal submitted by the Ohio Gas & Electric Company of Lisbon to take over the municipal electric plant. The company offers to pay $30,000 for the plant and agrees to expend $25,000 for improvements to the system as soon as it is turned over.

SALEM, OHIO.—Preliminary steps have been taken by the Salem Lighting Company for extensions and improvements to its plant, including the installation of new boiler equipment, to cost about $10,000.

WILLOUGHBY, OHIO.—The Cleveland, Painesville & Eastern Railroad Company has petitioned the Public Utilities Commission for permission to issue $68,000 in bonds, the proceeds to be used for extensions and improvements to its system.

YOUNGSTOWN, OHIO.—Several large power contracts have been closed by the Mahoning & Shenango Railway & Light Company for furnishing electric energy to industrial plants. One is with the Ohio Steel Products Company of Mineral Ridge, a new fabricating industry, calling for approximately 600 hp.; another calling for 1500 hp. for the Crescent Portland Cement Company's plant at Crescentdale, which will require the erection of a transmission line crossing the Beaver River near the plant; the third is with the Valley Mould & Iron Company of Sharon to furnish about 300 hp. at its new plant now being erected at West Middlesex, Pa.

FRANKFORT, KY.—An ordinance has been adopted by the City Council requiring the Kentucky Traction & Terminal Company to replace the wooden poles now in use on parts of Main and St. Clair Streets with ornamental steel poles; also the electric and telephone companies to place their wires in underground conduits along these thoroughfares.

LOTHAIR, KY.—The Kentucky River Power Company of Hazard, which has recently completed a large power plant in Lothair, is planning to erect electric transmission lines into the Lott's Creek field to furnish electricity to coal-mining companies in that district.

MAYSVILLE, KY.—Cochran Brothers, who last winter contracted for equipment for a large power plant, have asked for bids for construction of a power house. The plant, which will be equipped for three-phase, 60-cycle, 2300-volt current, will furnish energy to the January & Wood Company cotton mills, the Maysville Gas Company, which will change its system from two to three-phase, and to the Maysville Street Railroad & Transfer Company. The system will be operated by a company yet to be formed. It is expected to have the plant in operation by Jan. 1, 1918.

RICHMOND, KY.—Contract has been awarded by the Richmond Water & Light Company for improvements to its reservoir.

WHITESBURG, KY.—The electric-light franchise recently sold by the City Council was purchased by W. C. Daniels of Monica, who will start work at once on construction of a plant, to cost about $30,000. The proposed plant will also furnish electricity to several coal-mining corporations starting developments in the immediate section of the city. Local transmission lines will be extended.

SOUTH BEND, IND.—The capital stock of the Indiana & Michigan Electric Company has been increased from $3,500,000 to $5,000,000.

SULLIVAN, IND.—The Terre Haute, Indianapolis & Eastern Traction Company of Indianapolis has been granted permission by the County Commissioners to extend its electric transmission lines to the mines of the Vandalia Coal Company.

WARSAW, IND.—The Public Service Commission has granted the Winona Electric Light & Water Company permission to sell $85,000 in bonds.

DEKALB, ILL.—Bids will be received by the city of DeKalb for the purchase of 64 General Electric 6.6-amp. luminous magnetite arc lamps, now in service, on its boulevard lighting system. For details see proposal columns.

GALESBURG, ILL.—The stockholders of the Galesburg Railway, Lighting & Power Company have voted to increase the capital stock of the company from $3,500,000 to $4,000,000.

PARIS, ILL.—The installation of a new electric-lighting system in the business district is under consideration by the Board of Local Improvements.

SCALES MOUND, ILL.—The C. L. Walton Lighting Company, recently incorporated with a capital stock of $2,500, is planning to furnish electrical service here.

SHERRARD, ILL.—The State Public Utilities Commission has given to the Sherrard Power System, recently incorporated, permission to purchase the local electric-lighting system owned by D. W. Bowen. The company is capitalized at $30,000 and proposes to furnish electricity for lamps, heaters and motors in Sherrard and Pre-emption.

MARINETTE, WIS.—Work will soon begin on the construction of a hydroelectric development on the Brule River, just below the junction of Brule and Paint Rivers, by the Twin Falls Power Company.

MILWAUKEE, WIS.—The Standard Oil Company, Germania Building, is contemplating the construction of a garage and repair shop, 90 ft. by 140 ft., two stories and basement, at Walker and Barclay Streets, to cost complete about $27,000. The plans provide for a steam power plant and a 70-ft. stack.

NEENAH, WIS.—Steps have been taken by the residents of Neenah and Menasha to secure funds for the installation of an ornamental lighting system on Nicolet Avenue, the dividing line between the two cities.

WAUPUN, WIS.—Plans are being considered for the installation of an ornamental lighting system on Main Street. Vaughn & Meyer of Milwaukee, are engineers.

IRONTON, MINN.—Bids will be received by the Village Council until June 5 for the construction of a village hall and jail, including general contract, heating and plumbing and electrical work. Nelson & Beautow of Perham are architects.

LANESBORO, MINN.—Bids will be received by J. Solberg, clerk of school board of the independent school district 158, Lanesboro, until May 25 for construction of school building. Separate bids to be submitted on general construction, heating and ventilating, plumbing, and electrical work. Plans and specifications are on file in the office of G. L. Lockhart, Endicott Building, St. Paul, Minn.

PRINCETON, MINN.—Negotiations are under way, it is reported, between the City Council and the St. Cloud Power Company for the purchase of the municipal electric-light plant.

SUNRISE, MINN.—Plans have been prepared by J. C. Jacobson, Security Building, Minneapolis, for the installation of an electric-light plant for the Sunrise Milling Company.

BURLINGTON, IOWA.—The erection of several transmission lines this year, it is reported, is contemplated by the Burlington Railway & Light Company. One of the proposed lines will connect Burlington with Mediapolis, Morning Sun, Wapello and Winfield; another line will be erected from Burlington to Middletown. Energy will be supplied from the plant at the Keokuk dam to the cities and towns north of Burlington.

HUMBOLDT, IOWA.—The Northern Iowa Gas & Electric Company has been granted franchises to erect and maintain electric distribution lines on certain roads and highways in Humboldt and Palo Alto Counties by the Board of Railroad Commissioners.

LITTLE ROCK, IOWA.—Bonds to the amount of $15,000 have been issued for the installation of a municipal electric-light plant.

JOPLIN, MO.—The City Council is considering calling an election to submit to

the voters the proposal of the Empire District Electric Company offering to take over the municipal electric-light plant.

KANSAS CITY, MO.—The Kansas City Railways Company is considering the construction of a one-story substation, to cost about $7,000.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company has closed a contract with Morris & Company, packers, under which the St. Joseph plant of the packing concern will abandon their own electric plant and purchase energy from the street railway company. Plans, it is reported, are being considered by the St. Joseph company for the construction of a new power plant, to be located on the river front, not far from the stockyards.

SPRINGFIELD, MO.—The Federal Light & Traction, which controls the Springfield Railway & Light Company, is reported to be negotiating for the purchase of the local power plant of the Frisco Railroad Company.

VANDALIA, MO.—Contract has been awarded by the Walsh Fire-Clay Products Company to the Unit Construction Company, St. Louis, Mo., for the construction of a power plant.

COURTENAY, N. D.—At an election held recently the proposal to issue $7,000 in bonds for a municipal electric-light plant was carried.

WASHBURN, N. D.—Preliminary surveys have been made by E. D. Jackson of St. Paul, Minn., engineer, for the construction of an electric power plant at Bismarck, 6 miles distant. A company has been organized, with a capital stock of $150,000, to operate the system. It is proposed to furnish electricity in Washburn, Turtle Lake, Denloff, Goodrich and other towns in this district.

BELLE FOURCHE, S. D.—A company has been organized under the name of the North Star Electric Railway Company to build an electric railway from Belle Fourche to Dickinson, via Scranton. The construction of an electric power plant is contemplated in connection with the project. F. E. Duba is interested.

GREELEY, NEB.—Plans are being considered for the installation of an electric-light plant in Greeley, to cost about $15,000. P. A. Johansen of Anita is reported interested in the project.

ARCADIA, KAN.—The City Council is considering the erection of an electric transmission line to Pittsburg to secure electricity for distribution in Arcadia.

ARGONIA, KAN.—The Western Sumner Light & Power Company of Argonia and the Tri-County Light & Power Company of Norwich have applied to the Public Utilities Commission for permission to operate in and near the towns of Norwich, Milton, Viola, Mayfield and Argonia. W. L. Jones of Argonia is manager of both companies.

DOUGLAS, KAN.—At an election to be held May 22 the proposal to issue $5,000 in bonds for the installation of an electric-lighting system will be submitted to the voters.

MARYSVILLE, KAN.—The Marysville Light, Power & Water Company, it is reported, contemplates extensions to its local distribution system.

MEDICINE LODGE, KAN.—Harry Dobson and J. N. Tincher, owners of the local electric plant, have submitted a proposal to the town of Sharon, offering to erect an electric transmission line from Medicine Lodge to furnish electrical service in that town.

## Southern States

ROANOKE RAPIDS, N. C.—Contract has been awarded by the Roanoke Mills Company for construction of warehouses and 50 tenement cottages; contract will soon be awarded for an additional mill building, 542 ft. by 158 ft., to cost about $100,000, and for boiler house and reservoir. Contracts have also been placed for all machinery, costing $530,000, and will include 23,184 spindles, to be equipped for electrical operation. Later 700 wide looms will be installed. Energy will be secured from the transmission system of the Roanoke Rapids Power Company.

FELLSMER, FLA.—At an election to be held May 21 the proposal to issue $20,000 in bonds to purchase or construct an electric-light plant and ice factory will be submitted to the voters.

CUMBERLAND SPRINGS, TENN.—Plans are being considered by L. Motlow of Tullahoma for the construction of a hydroelectric plant to supply electricity for lighting hotel and 65 summer homes. It is proposed to build a concrete dam 300 ft. by 34 ft. and 21 ft. thick.

JACKSON, TENN.—Bids will be received by H. M. Harris, commissioner of public utilities, until May 24, for furnishing material for an ornamental lighting system, consisting of approximately 100 standards with wiring and accessories. For details see proposal columns.

DOTHAN, ALA.—Plans, it is reported, are being considered for a hydroelectric development in Dothan. T. M. Espy and W. L. Lee are reported interested.

OZARK, ARK.—Plans are being considered for improvements to the local electric-light plant. A. Littleton is manager.

SILOAM SPRINGS, ARK.—Two new boilers of 150 hp. each are being installed in the municipal electric-light and water plant to replace the boilers now in use.

PONCHATOULA, LA.—The property of the Ponchatoula Ice Company has been purchased by the Hammond (La.) Ice, Light & Bottling Company. Improvements will be made to the local electric system and a 24-hour service established. A new ice factory, it is understood, will be built.

COLLINSVILLE, OKLA.—Improvements are contemplated to the municipal electric-light plant, including the installation of new machinery, to cost about $14,000.

HEALDTON, OKLA.—The Consumers' Light & Power Company has purchased four additional lots in Healdton, on which it will erect a substation. The company proposes to supply electricity here over a high-tension line from its Ardmore plant.

POND CREEK, OKLA.—Plans are being considered for the erection of an electric transmission line to Enid to secure electricity for distribution in Pond Creek.

AUSTIN, TEX.—Plans are being considered for placing the electric wires underground in the business district.

PORT ARTHUR, TEX.—The installation of an ornamental lighting system in Port Arthur is under consideration.

## Pacific and Mountain States

COUPEVILLE, WASH.—A small electric-light plant is being installed by C. H. Coates & Son to supply electricity to neighboring farms.

INDEX, WASH.—The City Council has passed an ordinance providing for the construction of a municipal electric-light and power plant. G. N. Miller, engineer, of Seattle, will have charge of the work.

OLYMPIA, WASH.—To provide heavier power lines to the shipyards in Olympia, the Olympia Light & Power Company is putting new cross-arms on all poles on Main Street, to the end of the fill, and running wires. Additional energy will be brought from Tacoma.

SEATTLE, WASH.—Plans for the equipment of the new Sedro Woolley Hospital at the Veterans' Home at Retsil provide for a power house, to cost $35,000.

SEATTLE, WASH.—Contracts have been awarded by the Board of Public Works for machinery for the addition to the Lake Union steam power plant at a cost of $378,435, as follows: Charles C. Moore & Company of Seattle for all equipment, with the exception of the main turbine unit and exciter unit, at $231,035, and the Allis-Chalmers Company of Milwaukee, Wis., for the turbine unit and exciter unit, at $147,400.

SEATTLE, WASH.—The City Council has granted the Western Union Telegraph Company a franchise to construct and operate both overhead and underground wires and all apparatus necessary for furnishing private connections for messenger service, time service and ticker service and for local connections for long-distance telephone service. This is similar to the franchise granted the Postal Telegraph Company and in both cases supplemental to the general franchise under which the two companies operate.

SEATTLE, WASH.—The City Council has instructed J. D. Ross, superintendent of lighting, and L. B. Young, superintendent of water, to proceed with attempts to seal the leaks in the masonry dam at Camp 2, on Cedar River, source of light and water supply of the city of Seattle. W. D. Freeman, city purchasing agent, has been authorized to purchase one pumping outfit for use on fresh water sluicing, consisting of one or two pumps, directly connected to a 500 to 650-hp., 22,000 to 25,000-volt, two-phase, 60-cycle induction motor. The pumping unit is to have a capacity of from 3500 to 4000 gal. per minute against approximately 400-ft. head.

SEATTLE, WASH.—Bids will be received at the office of the general purchasing agent, Alaskan Engineering Commission, Seattle, Wash., until May 28 for furnishing one portable coal elevator and unloader. Copies of circular may be obtained upon application to the above office, the Alaskan Engineering Commission, United States Custom House, Portland, Ore.; United States Custom House, San Francisco, Cal.; United States Reclamation Service, 505 Tramway Building, Denver, Col.; Bureau of Mines, Fortieth and Butler Streets, Pittsburgh, Pa.; United States Reclamation Service, 802 Federal Building, Chicago, Ill., and Alaskan Engineering Commission, Washington, D. C. C. E. Dole is general purchasing agent.

EUREKA, CAL.—The Hammond Lumber Company, the Pacific Lumber Company and the Charles Nelson Company, all of San Francisco, have purchased a tract of land adjoining the Hammond Lumber Company's plant in Eureka, on which they propose to erect a shipbuilding plant and a sawmill, to be equipped with electrically operated machinery.

LONG ISLAND, CAL.—At an election to be held on May 22 the proposal to issue $8,000 in bonds for the installation of an electric-lighting system will be submitted to the voters. Energy will be purchased from the Phillipsburg (Kan.) Mill & Elevator Company.

OAKLAND, CAL.—The Board of Education has voted to increase the foundry and electrical shop equipment of the Technical High School.

ORANGE, CAL.—The Santiago Orange Growers' Association of Orange has voted to appropriate $100,000 for the erection of an icing and pre-cooling plant for Eastern shipment. The proposed plant will include an ice-manufacturing department, refrigerating plant, blower system, ice-conveying apparatus and other equipment.

SAN DIEGO, CAL.—Application has been made to the State Railroad Commission by the San Diego Consolidated Gas & Electric Company for permission to erect an electric transmission line from Oceanside to San Juan Capistrano to furnish electricity at the latter place.

SAN FRANCISCO, CAL.—The State Railroad Commission has refused to grant the Yosemite Power Company of La Grange the use of the Poopehaut reservoir and other works and right of way in Yosemite National Park.

BOISE, IDAHO.—High-tension transmission lines will be erected by the Idaho Power Company in the near future to the Boulder and Jarbidge mining districts. Owners of the Demming group have contracted for 500 hp. The line will be extended from Silver City to Boulder, a distance of 15 miles. The line to the Jarbidge district will be erected from the Thousand Springs plant to the new district, a distance of about 80 miles.

BONNERS FERRY, IDAHO.—The Bonner Water & Light Company is contemplating improvements to its plant. A. H. Featherstone is proprietor.

BINGHAM, UTAH.—The Utah Power & Light Company is contemplating the installation of ornamental lamps on Main Street.

PHOENIX, ARIZ.—Residents of the Higley District have formed Electric District No. 2 of Maricopa County, for the purpose of securing electrical service.

ST. JOHNS, ARIZ.—The Board of Supervisors has granted Gustav Becker a franchise to furnish electricity in Apache County. Electrical service will be furnished in Springerville, Eager and Round Valley.

## Canada

ALLISTON, ONT.—The ratepayers on May 7 approved a by-law authorizing an appropriation of $32,000 to take over the electric-light plant of the Alliston Electric Light Company, and for improvements to the system for the purpose of distributing energy to be supplied by the Hydro-Electric Power Commission of Ontario.

BALA, ONT.—The contract for the installation of an electric plant and street-lighting system has been awarded to Grant & Thorpe of Peterboro.

## Miscellaneous

EL CAYEY, P. R.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 5 for the erection of radio buildings, including two wood-frame quarters, one receiving building and one power house, complete with electric lighting, water, plumbing, sewer system, etc., at the high-power radio station at El Cayey. Drawings and specifications No. 2389 can be obtained upon application to the above bureau or to the commandant of the navy yard, New York, N. Y.

1,224,895. INDUCTION MOTOR; Ferdinand Blanc, Charlottenburg, Germany. App. filed Jan. 16, 1914. So constructed that the speed-torque characteristics of such a motor can be modified in order to meet particular service conditions, especially those required for driving spinning machinery.

1,224,908. ELECTRICAL CONNECTOR; Harry A. Douglas, Bronson, Mich. App. filed May 11, 1915. Two members are made relatively movable longitudinally of the structure to bring these members in either of two alternative relations.

1,224,966. ELECTRICAL DISTRIBUTION MEANS; Edmund O. Schweitzer, Chicago, Ill. App. filed Nov. 26, 1915. Distributing block in combination with a long, hollow metallic pole, the block being arranged to be inserted into the upper end of the pole to form a plug therefor and simultaneously to act as a means for connecting the overhead conductors and for enabling any of the overhead conductors to be connected with conductors contained within the interior of the pole.

1,224,970. LINEMAN'S SHIELD; Frank K. Singer, Pittsburgh, Pa. App. filed Nov. 3, 1916. Comprising a tube of flexible insulating material.

1,224,971. MULTIPLE-SERVICE CONNECTION; John T. Skinner, Lawrence, Kan. App. filed April 24, 1915. Serves not only as an incasement for the terminal connection bar disposed therein, but also as an insulator therefor.

1,224,983. ELECTRIC REGULATOR; Thomas S. Watson, Milwaukee, Wis. App. filed April 9, 1915. Provides a regulator for maintaining approximately constant the voltage on a regulated circuit operating at a voltage lower than that of the circuit from which it is supplied.

1,224,986. APPARATUS FOR CHARGING STORAGE BATTERIES; David H. Wilson, Ridgewood, N. J. App. filed Sept. 16, 1916. Reduces the charging current to a very low degree to allow the gases created by the charging to be dissipated, after which the current may again be increased to a high degree.

1,224,987. ATTACHMENT PLUG; Robeson B. Wolcott, East Cleveland, Ohio. App. filed Aug. 30, 1915. Can be readily wired.

1,225,014. ELECTRICAL TESTING APPARATUS; Caleb J. Conner, Coatesville, Pa. App. filed Nov. 6, 1915. Arrangement of non-inductive resistances and a galvanometer whereby to indicate approximately the point in an electrical circuit at which a fault, such as a ground, short circuit or the like, may exist.

1,225,051. PORTABLE ELECTRIC LAMP; Henry M. Peters, Chicago, Ill. App. filed July 6, 1916. Improved means for holding a shade thereon so that shades of various types may be interchangeably employed upon the lamp base as occasion may require.

1,225,052. PROCESS FOR TREATING ORGANIC COMPOUNDS BY ELECTROLYSIS; Alfred Piguet, Basel, Switzerland. App. filed Dec. 31, 1915. Improved method.

1,225,096. MOTOR CONTROLLER; Charles W. Yerger, Milwaukee, Wis. App. filed Oct. 28, 1913. In connection with electric elevators.

1,225125. ELECTRIC CABLE CLAMP; Monroe Guett, Hartford, Conn. App. filed April 24, 1913. Used for securing the end of a cable within a receptacle such as a wall casing in which an electric switch or some similar mechanism is to be installed.

1,225,127. CONNECTOR FOR CIRCUIT WIRES; Lewis W. Heath, Hastings, Mich. App. filed Aug. 2, 1915. Means by which the circuit wires may be quickly and effectively connected and as readily disconnected.

1,225,147. INSULATION; Fred M. Locke, Victor, N. Y., App. filed Sept. 4, 1914. Glass or porcelain of high silica content to prevent cracking from sudden changes of temperature.

1,225,175. APPARATUS FOR GENERATING ELECTRICITY; Sylvanus A. Reed, New York, N. Y. App. filed Jan. 16, 1914. Relates to the production of electricity directly from the oxidation of fuel in a battery or cell containing a fused electrolyte and requiring a heater or furnace to maintain fusion.

1,225,194. ARC-LIGHT ELECTRODE; Robert P. Walker, Cleveland, Ohio. App. filed Dec. 3, 1912. Novel way of arranging the end of the conducting wire in cored carbons.

1,225,227. RHEOSTAT; Charles W. Dunham, Edgewood Borough, Pa. App. filed Feb. 17, 1917. Including a biased bridging contact member of such a character that when traversed by current the biasing means for the member will be unaffected by such current, thereby insuring the proper functioning of the biasing means.

1,225,284. AUTOMATIC ELECTRIC GENERATING APPARATUS; Chester F. Strong, Des Moines, Iowa. App. filed Sept. 15, 1913. When the current being used or discharged by the apparatus is unusually heavy, the internal-combustion engine will be automatically started.

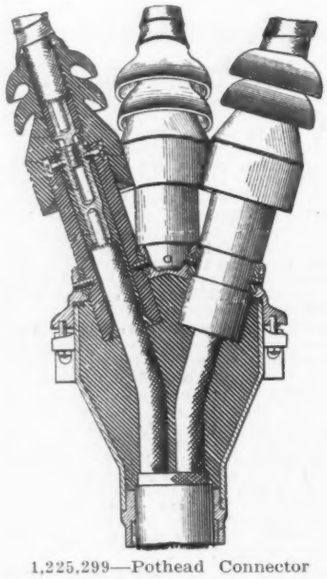
1,225,293. AUTOMATIC ELECTRIC GENERATING APPARATUS; Chester F. Strong, Des Moines, Iowa. App filed Nov. 8, 1912. Employs an internal-combustion engine, a dynamo-electric machine adapted to operate either as a motor or a dynamo, and a storage battery, together with automatically actuated elements.

1,225,297. CONNECTOR AND CONNECTION FOR STORAGE BATTERIES; Theodore A. Willard, Cleveland, Ohio. App. filed July 16, 1915. Improvement.

1,225,298. CONNECTOR AND CONNECTION FOR STORAGE BATTERIES; Theodore A. Willard, Cleveland, Ohio. App. filed July 16, 1915. Construction overcomes many of the difficulties attending the use of tapered plug connectors heretofore employed on storage batteries.

# *Record of Electrical Patents*

**Notes on United States Patents issued on May 8, 1917**



1,225,299—Pothead Connector

1,225,299. POTHEAD CONNECTOR; Paul F. Williams, Chicago, Ill. App. filed March 15, 1910. Constructional features are such as to render the assembly thereof a simple matter.

1,225,300. CONNECTING DEVICE FOR ELECTRIC CONDUCTORS; Paul F. Williams, Chicago, Ill. App. filed Dec. 11, 1911. Improvement of the design of cable potheads, particular reference being had to the inlet and outlet structures.

1,225,306. ELECTRIC BATTERY; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed Oct. 22, 1915. Dry cell.

1,225,312. SPEEDOMETER; Allen A. Canton, New York, N. Y. App. filed May 17, 1913. Electrically operated.

1,225,330. MAGNETO; Otto Heins, New York, N. Y., and Charles M. Wild, Springfield, Mass. App. filed March 1, 1916. Magneto for high-speed engines and particularly a magneto that can be driven directly from the crankshaft of a six-cylinder or a twelve-cylinder four-cycle engine.

1,225,337. SEPARABLE ATTACHMENT PLUG; Walter C. Jones, Chicago, Ill. App. filed Jan. 21, 1913. Comprises two body portions separably connected.

1,225,346. GRAVITY-BATTERY ELECTRODE; Patrick T. MacNamara, New York, N. Y. App. filed April 6, 1916. Larger contact surface and greater electrical contact with the solution.

1,225,357. VARIABLE-RESISTANCE DEVICE; Roy E. Reed, Ripon, Wis. App. filed Nov. 13, 1916. Improvements.

1,225,366. JOINT FOR ELECTRICAL CONDUCTORS; Charles B. Schoenman, Wilkinsburg, and Ralph M. Houch, Swissvale, Pa. App. filed Sept. 11, 1916. Improved.

1,225,368. METHOD OF MAKING RESISTANCE ELEMENTS; Melvin L. Severy, Arlington Heights, Mass. App. filed Jan. 15, 1914. The shape, direction, and inclination of the resistance curve can be controlled according to this invention.

1,225,373. METHOD OF ELECTRIC WELDING; Roland D. Thomson, Schenectady, N. Y. App. filed Aug. 21, 1916. Pressure applied by means of a rolling or sliding contact.

1,225,388. ELECTROMAGNETIC SWITCH; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Feb. 6, 1915. Operated by a coil responsive to the voltage across a given circuit.

1,225,391. ATTACHMENT PLUG; Ernst G. K. Anderson, Chicago, Ill. App. filed April 10, 1913. Separable.

1,225,411. ELECTRIC LIGHTING FIXTURE; Albert Cohn and Louis H. Debs, Chicago, Ill. App. filed Dec. 1, 1916. Pedestal lamp.

1,225,433. DETACHABLE CONTACT PLATE; George W. Gilmore, Alliance, Ohio. App. filed Sept. 14, 1915. May be readily detached from the support provided and replaced as desired.

1,225,457. COMBINATION COIL AND CONDENSER FOR DYNAMOS; Charles T. Mason, Sumter, S. C. App. filed Jan. 7, 1916. Positioning of the condenser nearer the primary winding of the coil than has heretofore been accomplished.

1,225,460. INSULATOR WALL BRACKET; James B. McCarthy, Birmingham, Mich. App. filed March 31, 1916. Improvements.

1,225,491. PORTABLE ELECTRIC LAMP; Adolph C. Recker, Oakville, Conn. App. filed Nov. 8, 1916. Improvement.

1,225,509. ELECTRIC WELDING; John A. Seede, Niskayuna, N. Y. App. filed Jan. 9, 1914. Supplying a control circuit with a resistance member having two adjustable portions and providing means for supplying current through one adjustable portion of the resistance at no load and through a different adjustable portion as soon as the load is thrown on the circuit.

1,225,525. OUTLET BOX AND SUPPORT THEREFOR; Oliver T. Sweet, St. Louis, Mo. App. filed May 25, 1914. Form the main body of the box from a single piece of sheet metal.

1,225,526. ELECTRICAL RECEPTACLE; George B. Thomas, Bridgeport, Conn. App. filed April 1, 1914. Adapted to receive plug devices of the well-known Edison-base type.

1,225,534. ELECTRICAL SYSTEM; Richard Varley, Englewood, N. J. App. filed April 27, 1915. Wherein a high-tension flow or discharge of current is effected at a current-using instrumentality such as a spark gap or the spark plug of a cylinder of an internal-combustion engine.

1,225,553. ELECTRICAL CONDUIT; Chauncey W. Abbott, Auburn, N. Y. App. filed June 22, 1914. Metal moldings.

1,225,580. ELECTRIC SWITCH; Harry E. Clifford, Cambridge, Mass. App. filed May 29, 1913. Oil.

1,225,587. PROTECTING MEANS FOR TRANSMISSION SYSTEMS; Elmer E. F. Creighton, Schenectady, N. Y. App. filed May 14, 1913. Mounts an arcing ring on the insulator carrying the conductor and connects this ring to the mast or tower through a resistance member so that the total resistance offered to a discharge from or to that conductor is of approximately the critical value.

1,225,614. CONDUIT CONNECTOR; Henry R. Gilson, Baden, Pa. App. filed Feb. 21, 1916. Two-part conduits.

1,225,631. PORTABLE ELECTRIC WATER HEATER; Clarence E. Hinkle, Roswell, N. M. App. filed Dec. 13, 1916. Improvements.

1,225,639. METHOD AND MEANS OF VOLTAGE CONTROL; Svend E. Johannesen, Pittsfield, Mass. App. filed Jan. 3, 1913. Automatically controlling the voltage on a circuit in any predetermined desired manner irrespective of the load changes.

1,225,686. ELECTRIC CONTROLLER; Harry F. Stratton, Cleveland, Ohio. App. filed Sept. 9, 1915. Improvements.

1,225,687. ELECTROMAGNETIC APPARATUS; Harry F. Stratton, Cleveland, Ohio. App. filed March 8, 1917. For controlling the acceleration of alternating-current motors from standstill to normal running speeds.